

# **Commodity Futures Manipulation: Theory, Evidence, and Regulatory Implications**

by

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## Abstract

This thesis is a collection of four separate papers with a core theme: commodity futures manipulation. It aims to answer three important questions. How vulnerable are futures markets to manipulation? What are the effects of manipulation? How should futures markets be regulated?

We first set up a one-shot game-theoretical model (Chapter 2) with certain classes of heterogeneously informed traders to consider how vulnerable a futures market to manipulation is, what influences this vulnerability and how manipulation affects the functioning of the market. This model predicts that futures manipulation may occur in equilibrium with a positive possibility if the deliverable supply is less than perfectly elastic, and the large trader possesses a certain amount of private information (here relating to his “type”), and more important, the functioning of futures markets is adversely affected by manipulation.

In Chapter 3, we attempt to extend the above analysis into a dynamic context with a slightly modified market structure with the purpose to show how a large trader can manipulate a market through dynamically strategic trading when the hedger trades rationally, observes contract delivery process and may opt out of futures trading. This model also predicts a positive probability of manipulation in equilibrium. One interesting result from this model is that the adverse effects of manipulation may be lessened due to the introduction of exogenous uncertainty in a futures market. This may justify certain types of regulation against manipulation initiated by exchanges or regulators, such as trading for liquidation only, emergency price or position limits, etc.

Chapter 4 moves to investigate empirically the economic effects of the alleged Sumitomo manipulation on the London Metal Exchange (LME). The results support our theoretical analysis. We find the evidence that the manipulation not only reduced the accuracy of “price discovery”, but also influenced the basis and basis risk in the futures market. Thus the functioning of the LME was undermined. Furthermore, by comparing

the actual LME cash price with a VAR forecast, we find that the LME cash prices were generally above the forecast prices during the period of alleged manipulation, but not significantly. Finally, we discuss the regulatory implications of futures manipulation in Chapter 5, and argue that manipulation should be one of the major concerns for futures regulation. We also undertake a comparative study of futures regulation in the US and the UK, and propose specifically how cost-effective futures (derivatives) regulation may be achieved in the UK.

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# Chapter 1

## Introduction

### 1.1 Background

Commodity futures markets have been beset by manipulation since the inception of futures trading over one hundred years ago. The earliest recorded futures manipulation in the US dated back to the mid-nineteenth century. It has been claimed that there was a corner a month in 1868 in Chicago grain markets (Taylor 1917, p.370). Some famous corners became legends in the late nineteenth century, such as the cornering of wheat contract of the CBOT by B.P. Hutchinson in 1888, the attempted manipulation of the CBOT wheat contract by Joe Leister in 1898, and the cornering of the gold market by Fisk and Gould (Kendall 1956 and Taylor 1917, pp.945-69), etc. These manipulative activities continued into the twentieth century. Partly because of widespread manipulation, futures trading was often condemned as legalised gambling. Futures manipulation clearly motivated US congressional concern over futures trading and resulted in the intervention of the federal government in 1921 with the first federal prohibition against manipulations. Since then, the US government has made many efforts to draft and enact legislation against manipulation, almost all of which explicitly make manipulation

a felony and are focused on prevention and punishment of manipulation.<sup>1</sup> This legislation led to the creation of the Commodity Futures Trading Commission (CFTC) in 1974, which is a specialised federal organisation to regulate futures markets. But concerns with manipulation and trading abuses did not lessen as a result of the creation of the CFTC. Manipulative events have remained in futures markets since then, examples being the manipulative attempt on December 1977 coffee futures contract on the New York Coffee and Sugar Exchange by Salvadorena, the Hunts silver manipulation around 1980 on the Chicago Board of Trade (CBOT) and the Commodity Exchange at New York (Comex), and the manipulative attempt on the July CBOT soybean futures in 1989 by Ferruzzi, etc.

The recent Sumitomo copper manipulation, which involved complex dynamic manipulative strategies over many years, and global trading co-ordination across different markets (worldwide cash copper markets, the LME and Comex futures markets, and possibly options and OTC markets), prompts even more serious issues. This manipulation clearly suggests that manipulation is not necessarily an ‘end of month’ effect as claimed by Edwards and Edwards (1984, p.343), and it may survive for a much longer period of time. The implications of the Sumitomo copper manipulation on futures (derivatives) regulation are far-reaching, especially on the UK futures (derivatives) regulation in which manipulation has not been a major legislative and regulatory concern.

The extensive futures regulation in the US is predicated mainly on the following views.<sup>2</sup> Firstly, futures markets are inherently vulnerable to manipulation. Secondly,

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<sup>1</sup>Main US statutory laws regarding manipulation include the Futures Trading Act of 1921 (FTA), the Grain Futures Act of 1922 (GFA), the Commodity Exchange Act of 1936 (CEA) which was the amendment of the GFA, and the Commodity Futures Trading Commission Act (CFTCA) which was the amendment of the CEA in 1974.

<sup>2</sup>These can be seen from Section 3 of the CEA which states: “Transactions in commodity involving the sale thereof for future delivery as commonly conducted on boards of trade and known as “futures” are affected with a national public interest; ... such transactions are utilized by shippers, dealers, millers, and others engaged in handling commodity and the products and by products thereof ... as a means of hedging themselves against possible loss through fluctuations in price; the transactions and prices of commodity on such boards of trade are susceptible to speculation, manipulation, and control, and sudden or unreasonable fluctuations in the prices thereof frequently occur as a result of such speculation, manipulation, or control, which are detrimental to the producer or the consumer and the persons handling

futures manipulation has adverse effects on the functioning of futures markets. the stabilisation of normal economic activities, and may impose appreciable costs on most of market users without providing a benefit in return. One might reasonably expect that because of the perceived importance of the subject and the vintage of the federal attempts at regulation, questions on manipulation would have been resolved, the effects of manipulation would be well-understood and effective means for manipulation prevention would have been achieved. However, the reality is to the contrary. These issues have not been adequately addressed theoretically, and empirical studies of the effects of manipulation are few. It is therefore not surprising that the rationale for futures regulation has not been well-understood. These questions motivate this research. This research has three purposes. The first is to investigate the vulnerability of a futures market to manipulation and to determine the factors influencing this vulnerability. The second is to identify and attempt to measure the effects of futures manipulation. The third is to explore the implications of futures market manipulation on futures regulation. It is our hope that this research may go some way towards filling to literature gap in this field, and provide a basis for understanding futures manipulation and addressing public policy for futures trading, and in particular, regulation of futures (derivatives) markets.

## 1.2 Literature Review

This section provides a brief analysis of work conducted on the issue of commodity futures manipulation. Commodity futures manipulation has been one of the most concern since the beginning of futures trading, but it has not been formally addressed by using standard economic theory until early 1980s. The relevant theoretical literature on this issue is therefore sparse, and this field is still not well-developed. However, from the beginning

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commodity and products and by products thereof ... and such fluctuations in prices are an obstruction to and a burden upon interstate commerce in commodity and the products and by-products thereof and render regulation imperative for the protection of such commerce and the national public interest therein.



there has been little disagreement that it is necessary for a manipulation to occur that there be a large or a group of large traders with market power in the market. Market power and monopoly in futures markets were modeled by Newbery (1984) and Anderson and Sundaresan (1984).

Newbery (1984) investigated futures manipulation by a dominant producer or speculator under symmetric information and rational expectations framework. He assumes that the dominant producer or speculator is less risk averse than the fringe competitors. His formal model concerns with one large risk neutral speculator initially and then producer, and a fringe of risk averse competitive producers. He demonstrates that when all agents have access to the same information sets and can predict the production or trading strategy of the large trader, the large trader has incentives to manipulate the market. But surprisingly, his result is that if the dominant trader exercises market power, the society is generally better off with its presence than with its absence. Anderson and Sundaresan (1984) examined the monopolistic behavior of a large producer when there is a futures market. Under rational expectations and with a risk averse large agent, they find the nature of equilibrium depends on the expectations and preferences of the large trader, and on the expectations, preferences, and cash market positions of the competitive traders. Specifically, they argue that only if the monopolist's costs and demand are highly positively correlated would his hedging induce him to corner a market in equilibrium. Both these models assume that there is perfect information in the market, and investigate how the large trader's behaviour diverges from competitive behaviour. The large agent can manipulate the futures market simply because of his dominance. Actually, the large trader's behaviour in these two models is not strictly what futures manipulation usually refers (we will discuss the mechanics of futures manipulation in Section 1.5). Given that futures manipulation has been one of the most public and congressional concern on futures trading in the US, an appropriate theory of futures manipulation should address the following questions:

- How can a large trader acquire market power in general in futures markets?

- How does he exercise market power given other traders are trading rationally and strategically?
- How does futures manipulation differ from manipulation in the other markets?
- What determines the vulnerability of a futures market to manipulation?
- What are the costs of manipulation? and how can manipulation be deterred?

From the long history of futures manipulation, two key elements appear to have contributed to the success of a manipulation: the futures delivery mechanism, and asymmetric information in futures trading. Kyle (1984) presented the first formal model of commodity futures manipulation (a squeeze) which incorporates these elements. He derives the sufficient conditions for a manipulation to occur in equilibrium. In Kyle's model, the information is asymmetric since the manipulator is assumed to be capable of observing hedgers' order flows, and he exploits this advantage by amassing a large long position when hedgers are trading actively, or by obtaining short positions when hedgers are trading inactively. Other traders (here speculators) who can observe the combined order flows, are unable to detect the manipulator's presence in the market. They therefore sell at a price that on average is below the cash price prevailing at expiration when there is a squeeze. Thus the informed trader earns a profit, and a squeeze occurs in equilibrium. Since the hedgers are treated to be exogenous in his model and are the least informed, Kyle concludes that the hedgers lose money consistently, and therefore squeezes discourage hedging. But the assumptions that there exists two delivery grades of a commodity in the market and a trader must have inside information about hedgers' order flows in the model are so restrictive that it is almost not applicable in practice, and therefore, it fails to explain how manipulation occurred in any actual market. Following a slightly modified model structure of Kyle (1985), Kumar and Seppi (1992) investigated the susceptibility of futures markets to price manipulation, and demonstrated that manipulation can even occur in equilibrium in a cash settlement market. But the mechanism

involved there is different from that of a “corner” or “squeeze” in delivery-settled futures markets which is the focus of our attention in this research.

Jarrow (1992) investigated market manipulation trading strategies by large traders in a securities market more generally. He argues that whether large traders can manipulate prices to their advantages and generates profits at no risk depends on the properties of the price process as a function of the speculator’s trade, and the existence of market manipulation strategies is related to the dependence of price process on the past sequence of the large trader’s holdings. Jarrow derives the sufficient conditions of the existence as well as nonexistence of equilibrium manipulation strategies. Specifically, under certain conditions, a large trader can profitably squeeze shorts by forcing them to liquidate their positions at an arbitrarily high price if he acquires a long position in a derivative security and the security deliverable against the derivatives which is larger than the aggregate supply. But Jarrow’s focus is manipulation in a securities market, and he is not aware of the importance of the underlying delivery market conditions on futures manipulation strategies. His theory is therefore unable to explain why futures manipulation does not occur more often in any actual markets.

Recognising the importance of the delivery process on futures manipulation and extending the Kyle’s two grades of a commodity to a more general situation where the supply of deliverable stocks on a futures contract is imperfectly elastic, Pirrong (1995b) presented a model to explain how manipulation occurs in equilibrium and what determines the severity and frequency of manipulation. In his model, there are three types of traders in the market: a large trader, market makers and noise traders. Pirrong shows manipulation may occur with a positive probability in a market provided that: (i) noise traders cause unpredictable variations in order flow; and (ii) the supply curve in the delivery market is less than perfectly elastic. Pirrong’s theorem provides a helpful explanation why corners sometimes occur in futures markets, and identifies factors that affect the susceptibility of a futures market to manipulation, but it is insufficient to show why some markets with sufficiently high level of noise trading and imperfect elasticity of

supply in the delivery markets, are not cornered all the time.

More recently, Chatterjea and Jarrow (1998) modeled the US Treasury securities auction market and demonstrated that market manipulation can occur in a rational equilibrium. The mechanics of manipulation in the US Treasury securities market are similar with those of corners or squeezes in commodity futures markets. In the when-issued-market traders are allowed to sell short, but they must cover their short positions by buying back the auctioned securities (substitutes are not acceptable). A Government bond dealer (or a group of dealers) can partially observe the order flow in the when-issued-market. When he observes large short-selling, he may bid aggressively during the auction and control majority of the securities, and consequently, some shorts are unable to cover their positions with the auctioned securities and have to purchase the on-the-run Treasury in the secondary market. The shorts therefore get squeezed. In order for a ‘squeeze’ to occur, the dealer must be able to observe the order flow, and this type of manipulation, with the similar informational assumption as Kyle’s, is therefore only applicable to some specific auction mechanisms. Chatterjea and Jarrow therefore suggest that the dealer’s ability to corner or squeeze the market differs across auction types, and argue that the UPA (unit price auction) is revenue superior to the DA (discriminatory auction).

Since part of our motivation of this research is to address futures regulation, thus major existing literature on futures regulation is also briefly discussed here. Our general perception is that, futures (derivatives) regulation has not been well explored compared with regulation of other financial sectors. Stone (1981) analysed the principles of futures regulation. Although brief, his “tripod” theory that generalises rationale for regulating futures markets may be still valid today. The “tripod” theory proposes that reasons of futures regulation lie in: (i) protecting customers; (ii) regulating against the potential of abuses of concentration by large position holders; and (iii) regulating against natural monopoly in futures exchanges or clearing houses. Edwards (1981) gave the first comprehensive analysis of the rationale for futures regulation, which provides justifications of

government regulation over futures markets in the United States. Edwards and Edwards (1984) and Easterbrook (1986) investigated specifically the regulation of futures markets against manipulation. However, their conclusions differ on whether self-regulation is sufficient to prevent manipulation. Edwards and Edwards (1986) were inconclusive on this issue, but Easterbrook (1986) concluded that exchanges can offer satisfactory precautions against manipulation. Fischel and Ross argued that, since manipulation in financial markets (including futures manipulation) is likely to be self-detering and enforcement of prohibitions is likely to be costly, and therefore, “actual trades should not be prohibited as manipulative regardless of the trader’s intent” (Fischel and Ross 1992, p. 553). Pirrong (1995a), however, argued that self-regulation is not sufficient in regulating futures markets. Anderson (1986) surveyed futures regulation as practised in the US and the UK, but he did not explore the rationale for futures regulation, and therefore, he was unable to explain why there exist differences in these two futures regulatory systems. It is not surprising that, views on how to regulate against futures manipulation may differ since it seems that there has not been a comprehensive framework to analyse the mechanism and the effects of futures manipulation.

Given this background of research on this issue, let’s briefly mention the contributions of this thesis. We basically focus on the reformulated Millsian critique by Anderson (1992, pp.961-962) to investigate whether actual manipulation occurs in a futures market even if hedgers anticipate this possibility. The general answer is yes. We then proceed to explore what affects the vulnerability of a futures market to manipulation. Our theoretical analysis of commodity futures manipulation in Chapter 2 and Chapter 3 contributes to the existing literature on this issue in three important aspects. First, we take into consideration of asymmetric information and its associated adverse selection problem. We assume the large trader in a futures market has two “types” (a manipulator or a speculator) which are not certain to other traders. This asymmetric informational assumption is more realistic than Kyle’s, but it is totally ignored by Pirrong (1995b). Second, we explicitly model hedgers’ behaviour, which is treated as exogenous in Kyle (1984) and absent

in Pirrong (1995b). Traders' behaviour can be characterised in optimisation framework. Finally, we extend conventional static equilibrium analysis of futures manipulation into a dynamic context, which essentially allows us to see whether manipulation remains an equilibrium strategy in a dynamically strategic trading environment. Following our theoretical analysis of manipulation, we examine the empirical evidence of the effects of the Sumitomo copper manipulation in Chapter 4. We then explore the precise rationale for futures regulation and conclude futures regulation should raise special concerns. We propose a maybe more cost-efficient manipulation deterrence framework and discuss UK futures regulation specifically. We argue that futures regulation in the UK, which is currently silent on futures manipulation, should be modified to make manipulation illegal.

### 1.3 Structure of the Thesis

The thesis comprises six chapters with a focus on the following three closely related topics with regard to commodity futures manipulation.

- How can manipulation occur in equilibrium? including an investigation of the vulnerability of a futures market to manipulation and equilibrium manipulative strategies in a commodity futures market by using game theory and market microstructure theory.
- How serious is manipulation? including a theoretical identification of manipulation effects and an empirical examination of the economic effects of the alleged Sumitomo copper manipulation by using LME metals data.
- How should futures (derivatives) markets be regulated? including an exploration of the precise rationale for futures regulation and a comparative study of futures regulation in the US and the UK.

In the next two sections of this chapter, we provide a general overview of futures trading, the functions of futures markets, the definition and mechanics of futures manipulation.

The main parts of the thesis consist of Chapter 2, Chapter 3, Chapter 4 and Chapter 5, which arise from four separate papers written over the past three years. Chapter 2 and 3 provide two theoretical models of commodity futures manipulation. Chapter 4 investigates empirically the economic effects of the Sumitomo copper manipulation on the LME, and Chapter 5 discusses regulatory implications on futures (derivatives) markets.

Chapter 2 mainly deals with a one-shot game-theoretical model with four classes of heterogeneously informed traders: a large trader, one representative hedger, market makers and noise traders. The game is played by the large trader, the hedger strategically. The aim of this model is to demonstrate that how vulnerable a futures market to manipulation is, what determines this vulnerability and how a manipulation affects the functioning of the futures market. This model predicts that futures manipulation may occur in equilibrium with a positive possibility if the delivery market is less than perfectly elastic, and the manipulator possesses a certain amount of private information (here relating to his “type”). Most important, the price discovery function of futures markets is adversely affected and hedging is discouraged in the presence of manipulation.

In Chapter 3, we attempt to extend the above model into a dynamic context within a slightly modified market structure. We construct a two-period model with three classes of traders: one large trader, one representative hedger and noise traders. The purpose of this model is to show how a large trader can manipulate a market through dynamic strategic trading when the hedger trades rationally, observes contract delivery process and may opt to stay out of futures trading. This model also predicts a positive probability of manipulation in equilibrium, but this probability may be lower than that in the static model even the delivery market structures are the same. The idea is that hedgers’ learning processes can themselves, though to a certain extent, constrain the large trader’s behaviour to be competitive. This result may help to explain partially why manipulation

occurs less frequently in an actual market even with high liquidity and inelastic supply curve in the delivery market. One interesting feature of this model is that, due to the introduction of a new variable (market uncertainty) into the system, the adverse effects of a manipulation may become less serious than what our one-period model predicted, since a manipulator has to take this uncertainty into account when he makes his trading decisions. This result may justify certain types of regulation against manipulation by exchanges or regulators, such as trading for liquidation only, emergency price or position limits, discretionary margin adjustments, trading halts, etc.

In Chapter 4, we use LME metals (copper and aluminium) data to test the effects of the alleged Sumitomo copper manipulation empirically. The empirical results support our theoretical analysis. We find the evidence that the manipulation not only influences the relationships between the futures price and the expected future cash price, but also affects the contemporaneous relationships between the futures price and the cash price, i.e., the basis. We also investigate the effects of the alleged manipulation on the LME prices by using a simple VAR approach. We found that the actual LME prices were generally above the VAR forecast prices over the period of alleged manipulation, although not significantly.

Chapter 5 discusses the regulatory implications of futures manipulation. If futures manipulation is an equilibrium phenomenon in commodity futures markets, and manipulation reduces the accuracy of price discovery and discourages hedging activities, anti-manipulation should be the primary rationale for futures regulation. This Chapter also reviews and compares how futures markets have been regulated in the US and the UK. In addition, in Chapter 5 we propose a maybe more cost-efficient manipulation deterrence framework, which consists of a large trader reporting system, a more rigorous *ex post* manipulation prosecution methodology and a certain amount of emergency anti-manipulation firepower. Specifically, we discuss UK futures (derivatives) regulation and argue how UK futures (derivatives) regulation should be reformed to reinforce the anti-manipulation impact.



The final chapter concludes this research and points to the direction of future research.

## 1.4 The Economic Functions of Futures Markets

To help understand the subject of commodity futures manipulation, in this and the following section, we provide a simplified review of futures trading, explain the economic functions of futures markets, define futures manipulation and describe the mechanics of commodity futures manipulation.

As their name suggests, commodity futures exchanges are centralised marketplaces where traders buy and sell commodities for delivery in the future. A commodity futures contract is a standardised contract – pursuant to the rules of a particular commodity exchange. The party undertaking the obligation to purchase is referred as the “long”, and the party undertaking to sell and possibly to deliver the commodity is referred as the “short”. By the time a contract expires, all traders must have settled, either by making an equal and opposite offsetting transaction or by an EFP (exchange futures for physical) or by delivery. Some longs may hold their positions and take delivery at the contract expiration, but most traders close out their contracts prior to the contract’s expiration by purchasing an offsetting contract, thereby cancelling their obligations.

A futures contract involves a commitment to deliver, or to take delivery of a specified quantity of some assets or commodities at a particular future date at a price determined at the time of contracting. This definition also characterises a forward contract. The key elements which distinguish a futures contract from a forward contract are: firstly, futures contracts are marked to market at the end of each trading day, so that futures contracts have zero equity value, while forward contracts have positive or negative equity value prior to the maturities of the contracts; secondly, futures contracts are traded on organised exchanges and hence acquire all the features of a liquid financial asset. It is this ability to retrade the asset which allows groups of individuals who have no intention of either making or taking delivery of the underlying commodity to establish an important

trading presence in the market; and thirdly, futures contracts are highly standardised and guaranteed by an intermediating clearing association, which implies futures trading may involve basis risk but substantially eliminate default risk.

Viewing a futures contract as a security, it has two significant characteristics which contribute to the special role it performs in an economy. Firstly, as a derivative security, its payoffs depends directly on the prices of other well-defined assets or commodities, in contrast to bonds or equities, where the links to prices are generally much more diffuse. Secondly, because of this link to prices, there will be a high correlation between the profits and losses on a given contract and the value of the endowments of those with an appreciable degree of exposure to the risk of fluctuation in the price of the underlying assets. The second characteristic is an obvious consequence of the first, and creates a use for the security as a hedging instrument, or in other words as a means of acquiring insurance against certain specific forms of risk. It is one of the two widely recognised functions of futures markets, which is usually termed “price insurance” or “risk-shifting”.

Another important economic benefit of futures markets is termed “price discovery”, which arises from the fact that futures contracts are competitively traded on organised exchanges. Price discovery is the revealing of information about the future cash market prices through futures markets. Futures prices thereby aid market observers in making their own predictions of the future cash prices. Futures trading takes place on organised futures exchanges, where all trading on a commodity is centralised on the floor of the exchange or through an exchange supported screen-based computer trading system. All the prices, which are the outcome of open and competitive trading on the floors of the exchange, reflect current market expectations about what cash price will be, or what underlying supply and demand for a commodity will be in the future. A futures price that is substantially higher than current price indicates a market expectation that there will be a relative shortage in the future; on the other hand, a futures price that is considerably lower than current price reflects a market expectation that there will be excess supply or slack demand of a commodity in the future. By reflecting information

and expectations about future supply and demand of a commodity, the futures price coordinates producers' and consumers' decisions about storage, production, consumption, etc. Therefore, a futures market serves an important social purpose by helping people make better estimates of the future cash prices so that they can make their consumption and investment decisions more wisely (Kolb 1994, pp.22-23).

## 1.5 Economics of Futures Market Manipulation

Whereas a futures market is concerned with obligations coming due at some future time, a cash market may be equated with immediate or forward physical requirements. Consequently, cash prices fluctuate with the influences of supply and demand and, at any given moment, will reflect those conditions. Prices in futures markets, however, are based on anticipated as well as current supply and demand and, will shift along with actual trends in production and consumption or predications of those trends as reflected on the trading floor. Therefore, there are inherent differences between futures trading and cash trading for the same commodity. The reasons for this discrepancy are complex. In general, as discussed in the previous section, futures markets are to provide a mechanism to forecast futures prices and to shift risks, but are not typically a source of supply of commodity itself (Bianco 1977, p.29).

Despite the distinctions between contracts negotiated in cash and futures markets, prices for the same commodity in the two markets follow parallel paths, i.e., the price relationship – the basis, defined as the difference between cash price and the futures price for a given commodity, remains fairly constant, but is not without variation under normal conditions. When a futures contract is at expiration, the futures price and the cash price for a commodity must be the same, i.e., the basis must be zero (assume there are no transaction costs). The nature of relative constancy and convergence of basis is guaranteed by the delivery requirements of a futures contract and arbitrage conditions. In a normal market, a futures price will exceed cash price, evidencing an available supply

of the deliverable commodity. If the basis widens by a futures price rising significantly over cash price due to a substantial supply increase, traders will “spread” by buying cash commodities at a lower cash price, while simultaneously contracting to sell the commodity at some future time at a higher price. These shorts may subsequently cover their positions by delivering their cheaply bought commodities in the futures market for profits. Conversely, if the commodity is in tight supply, the cash price will rise significantly over the forward price and the basis may become positive, which is termed a “backwardation”.<sup>3</sup> Under these circumstances, arbitrage does not work well, because of limitations on selling physical commodities short and other market frictions, and traders will therefore sell at a premium cash price. This expected premium, which is determined by anticipated demand and supply condition, may be sustained and affected by several factors, one of which is market manipulation.

Market manipulation is an activity or a set of transactions which is calculated to create fictitious demand and supply conditions. It takes several forms. Allan and Gale (1992) classified manipulation into three categories: action-based manipulation, information-based manipulation and trade-based manipulation. The first two categories of manipulation are not specific to futures markets, such as manipulating a market through rumours or false information conveyed into the market place, through “capping”, “pegging”, or “wash trading”, etc., which are well defined legislatively, juridically, and administratively in various laws, and in the rules of various exchanges and regulatory organisations.<sup>4</sup> For an example, section 5(c) of the Commodity Exchange Act makes it a condition of contract market designation that the exchanges’ governing board “provides for the prevention of dissemination by the board or any member thereof, of false or misleading or knowingly inaccurate reports concerning crop or market information or conditions that affect or

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<sup>3</sup>When a market is below full carry, there might be an opportunity for a reverse Cash and Carry arbitrage. This strategy requires selling cash short, but it is generally not possible in commodity markets. For a detailed analysis, see Kolb (1994, pp.81-105).

<sup>4</sup>Although there are still difficulties in identifying these types of manipulation accurately, they are clearly unlawful. For a discussion, see text and notes in Hirrington (1981, pp.248-49).

tend to affect the price of any commodity in interstate commerce”.<sup>5</sup> We do not intend to discuss these types of manipulation in this research.

Trade based manipulations are most prevalent in futures (derivatives) markets. The most significant form of manipulation, and the one of the greatest concern, is market power manipulation. Market power is regarded as an ability to create and sustain a premium (manipulated or artificial price) by a trader, or a group of traders, either by buying many futures contracts, or a large quantity of the underlying commodities, or both, and demanding or threatening to demand a quantity of delivery which exceeds the normal available supply of deliverable stocks at expiration, in order to create an artificially “tight” supply condition (the monopoly power); or by selling many futures, or a large quantity of the underlying assets, or both, and intending to make so much delivery that no other traders are able to take or through excessive sales to drive the market price to an artificial level (the monopsony power). Market power manipulation essentially eliminates effective price competition in a market for cash commodities and/or futures contracts by a large trader or a group of large traders through the domination of either supply or demand, and the exercise of that domination to produce artificially high or low prices. This type of manipulation requires large resources and may cause devastating effects on a futures market, financial integration, and the stability of whole economy.

However, futures manipulation has not even been defined by statute in the US, and legal definition of manipulation has instead been derived through specific manipulation cases<sup>6</sup> which involve different markets and circumstances. It is not surprising that the emphasis of definition may shift from one term to others. Edwards and Edwards (1984) generalised three essential elements of a manipulation from manipulation case laws. These are: (i) price artificiality, i.e., the creation of an abnormal or artificial price; (ii) causation,

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<sup>5</sup> 7 U.S.C. 7(c) (1976 & supp. III 1979).

<sup>6</sup> Key manipulation court cases in the United States include: *General Foods Corporation v. Brannan* (170 F.2d 220, 231, 7th Cir. 1948); *Great Western Food Distributors, Inc. v. Brannan* (201 F.2d 476, 479, 7th Cir. 1953); *Volkart Bros. v. Freeman* (311 F.2d 52, 58, 5th Cir. 1962); *Cargill, Inc. v. Hardin* (452 F. 2d 1154, 8th Cir. 1971).

i.e., the accused trader caused the abnormal or artificial price; (iii) intentionality, i.e., the accused trader has acted with manipulative intent. Unfortunately, there has not been established standards for either an artificial price or causation of such price, and inferring intent from accused trader's actions is even more burdensome.

Except for the possible existence of market power in futures trading, the possibility for futures manipulation is additionally facilitated by the anonymity and imperfectly matched hedging (or "cross hedging", see Anderson and Danthine 1981) which are commonly regarded as the merits of futures trading in contrast with other trading forms. A trader holding long futures contracts may either offset by selling equal opposite contracts or by standing for delivery. He may find it is more profitable to stand for delivery when he acknowledges that there is a "tight" supply in underlying commodities if he has acquired a large quantity of futures contracts at lower prices, and the shorts, who find the cost of marginal delivery is substantially high or with no intention to make delivery, have to pay a premium to be released from contracted obligations. The first issue confronting a manipulator is how to acquire a large position from other intelligent traders. The possibility of accumulation of a large quantity of futures contracts is partially provided by the anonymity characteristic of futures trading, which is to facilitate trade among strangers and effectively a form of asymmetric information in futures trading. As Kyle put it, "the organised structure of futures trading makes it unnecessary for traders to know individually the principals on their other side of the transaction, because the brokers on the trading floor bring traders off the floor together behind a wall of anonymity and because the clearing house of the exchange guarantees the integrity of positions on both sides of the market" (Kyle 1984, p.143). It is one of the major virtues of futures trading indeed, which promotes liquidity and reduces transaction costs of futures trading, and makes futures markets an attractive form of market organisation. The contribution of imperfectly matched hedging allows the potential of manipulation. Hedgers are traditionally major players in commodity markets: they enter into futures contracts to protect their profit margins on physical commodities they are producing or must use or are committed

to buy or sell in the future. Often hedges are against physicals that do not correspond exactly to the commodity specified in the futures contract but that typically follows it closely in price. It is usually this imperfectly matched hedging that is used by a manipulator to force the hedgers, who have been persuaded by the liquidity of the market to short futures contracts against cash positions that are not themselves deliverable, to pay a high premium.

If a trader or a group of traders manipulate a futures market involving buying futures contracts, or both futures contracts and underlying commodities, we usually term this type of manipulation “long manipulation”; while manipulation involving selling futures contracts, or selling both futures contracts and underlying commodities, is termed “short manipulation”. Evidenced by the long futures manipulation history in the United States, as noticed by many commentators, short manipulations are rare.<sup>7</sup> The reason for scarcity of short manipulations may be regarded as short manipulation being more costly (Edwards and Edwards 1984, p.343; Johnson 1981, p.731). Long manipulation is our major concern in this research.

The long manipulation related to the “tight” supply conditions are usually distinguished by the terms a “corner” or a “squeeze”. Following Kyle (1984, pp.144-45), we refer a “corner” in this research to the case that a trader manipulates a futures market through controlling over large enough deliverable stocks or both deliverable stocks and large futures positions to set up a temporary monopoly in the commodity. Under this circumstance, the deliverable supply becomes “tight” for the hedgers and other traders mostly because the deliverable supply is captured by the manipulator. While in a squeeze, a manipulator exploits the delivery mechanism of the futures contracts by taking advantage of the fact that the deliverable supply is not easily available for delivery on favorable terms, and he makes profits either by threatening to take delivery and thereby

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<sup>7</sup>Only few cases were suspected as downward manipulations. One of those cases was Kosuga manipulation of the CBOT onions market by holding virtual monopoly on cold storage onions deliverable in Chicago, simultaneously, during the final two weeks in February 1956, maintained their short positions in March 1956 onion futures. Short manipulations may require even large resources, and are possibly confined to some perishable commodity futures contracts.

forcing shorts to bail out at high prices to avoid the high costs of making delivery, or by taking delivery of so much of the commodities that the shorts would not acquire at the cheapest to deliver. In futures markets, the term “cornering” has been therefore used to characterise the situation where a trader acquires a large long position in both the futures and in the supply of deliverable stocks against the futures to force the shorts to offset at a price which may be characterised as arbitrarily high; while the term “squeezing” is used to characterise a less extreme situation where a trader may not involve in cash transactions, but for one reason or another deliverable supplies of the commodity in the delivery month are low, while the manipulator’s long position in the futures market is considerably in excess of the deliverable supplies.

Although it may be beneficial to make a distinction between a “corner” and a “squeeze” when we consider the causes of manipulation, as noticed by many researchers, the distinction between a ‘corner’ and a ‘squeeze’ is not sharp and precise for a number of reasons. Nevertheless, traders in futures market face similar consequences in the presence of either types of manipulation: the marginal cost of delivery is increased, so is the equilibrium futures price. Typically, when a long manipulation develops, a short may face the following possibilities to offset her futures position:

- Default. The short refuses to perform the contractual obligations specified in the futures contract, specifically the delivery obligations. The cost of default is usually very high and default has been prohibited in the contract specifications, although in some seldom cases, in order to prohibit any possibility of a squeeze or a corner, some exchanges allow a short to default on contracts.<sup>8</sup>
- Orderly liquidation and cash settlement forced by an exchange or government regulatory authority. For example, on July 11, 1989, the Board of Directors of the

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<sup>8</sup>For example, Chicago Board of Trade adopted rules in 1869, 1870 and 1921 to allow a short to default. See Lurie (1975), *Commodities Exchanges as Self-regulating Organizations in the Late 19th Century: Some Perimeters in the History of American Administrative Law*, *Rutgers Law Review*, 28, p.1107; see also, 5 FED. TRADE COMM’N, REPORT ON THE GRAIN TRADE 27, 52, 1921, p.253.



CBOT with the approval of the Commodity Futures Trading Commission issued an emergency order: “ ... any person or entity ... who owns or controls a gross long or gross short position for any purpose whatsoever in excess of three million bushels in the July 1989 soybean futures contract traded on the Exchange must reduce said position ... by at least 20% per trading day ...”.<sup>9</sup>

- Deliver commodities that would not be cheapest to deliver, which involves to deliver higher grade of deliverable commodities but with no or little premium in the prices for those physical commodities, or to deliver non-cash settled financial products whose price is higher than “cheapest to deliver” products (the most potential is bond futures).
- Liquidate their positions at or slightly below the marginal cost of delivery. Shorts agree to bail themselves out at a premium, and usually result in huge losses. This is a normal solution for most manipulation cases.

The first two possibilities take place only when exchanges or regulatory authority realised a manipulation was developing and took emergency actions, which are only possible in limited large and obvious cases. In most cases, shorts have to agree to close out their positions at a substantial premium.

Whether it is a “corner” or a “squeeze”, manipulation discourages hedgers’ use of futures markets by imposing the cost of hedging, and has pronounced price effects and basis effects. Both are harmful to the functioning of futures markets.

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<sup>9</sup>See Division of Trading and Markets, the Commodity Futures Trading Commission, Memorandum to the Commission, Sept.1989; see also Barnhart, Kahl and Barnhart (1996, pp.781-82). There were some other cases involving liquidation and cash settlement measures ordered by exchanges or regulatory authority. For an example, the May 1976 Maine potato futures contract traded on the New York Mercantile Exchange to be ordered to trade for liquidation only, the New York Mercantile Exchange did later amend it’s Maine potato futures contract on 21 January, 1983 to include mandatory cash settlement in lieu of physical delivery.

# Chapter 2

## A Simple Model of Futures

## Manipulation with Heterogeneously Informed Traders

### 2.1 Introduction

Futures trading has been extensively regulated in the United States since the passage of the first federal futures trading legislation in 1921. The extensive regulation over futures trading is predicated mainly on the following views. First, futures markets are inherently vulnerable to manipulation. Second, futures manipulation has adverse effects on the functioning of futures markets, and may impose appreciable costs on market users without providing a benefit in return. However, these issues have not been adequately addressed theoretically.

Several models have attempted to investigate these issues. Kyle (1984) presented the first formal model of futures manipulation, and derived sufficient conditions for manipulation to occur in equilibrium. In Kyle's model, a large trader with superior information about the order flow from hedgers, exploits this advantage by amassing a large long position when hedgers are trading actively, or by obtaining short positions when hedgers

are trading inactively. Other traders (speculators) who can observe the combined order flows, are unable to detect the manipulator's presence in the market. They therefore sell at a price that, on average, is below the cash price prevailing at expiration when there is a manipulation. Thus the informed trader earns a profit, and a manipulation occurs in equilibrium. But the assumption that a trader must have inside information about hedgers' order flows in the model is so restrictive that it is almost inapplicable in practice. The model therefore fails to explain manipulation in any actual market. Jarrow (1992) investigated market manipulation trading strategies by large traders in a securities market. He argues that the ability of large traders to manipulate prices to their advantage and to generate riskless profits depends on the properties of the price process seen as a function of the speculator's trade. The existence of market manipulation strategies is thereby related to the dependence of price process on the past sequence of the large trader's holdings. He derives sufficient conditions of the existence, as well as nonexistence, of equilibrium manipulation strategies. Under certain conditions, a large trader can profitably squeeze shorts by forcing them to liquidate their positions at an arbitrarily high price if he both acquires a long position in a derivative security and the security deliverable against the derivatives larger than the aggregate supply. But Jarrow ignores the importance of the underlying market conditions on manipulation strategies, and therefore, his theory is unable to explain why manipulation does not occur more often in any actual market. Particularly in any commodity futures market, it is clear that a manipulator cannot force shorts to settle at an arbitrarily high price, since additional demand of delivery by the manipulator can always be met at finite costs.

Pirrong (1995b) also presented a model to explain how manipulation can occur in equilibrium and what determines the severity and frequency of manipulation. Pirrong shows manipulation may occur with a positive probability in a market with a certain amount of random noise trading and in the presence of an imperfectly elastic supply curve in the delivery market. Pirrong's theorem provides a helpful explanation why corners sometimes occur in futures markets, but is insufficient to show why some markets,

with apparently a sufficiently high level of noise trading and imperfect elasticity of supply in the delivery markets, are not cornered more frequently.

Although Pirrong's model provides insight in the equilibrium analysis of futures market manipulation, he does not model hedgers' behaviour explicitly. The fact that hedgers – traditionally the most important traders are missing in the analysis qualifies the value of his model. More important, Pirrong (1995b) did not take asymmetric information problem into account.

In fact, in addition to delivery market characteristics and noise trading, asymmetric information and its associated adverse selection problem may also play an important role in determining the vulnerability of a futures market to manipulation. When a manipulation is considered by other traders to be very likely, the equilibrium futures price may rise to reflect this probability, therefore limiting the ability of the large trader to profitably manipulate. This is similar to the reformulated Millsian argument by Anderson (1992). For a manipulation to occur, there must be some traders who are not well aware of the manipulator's presence in the market and who voluntarily stand on the other side of market. This requires asymmetric information, and asymmetric information is a central feature of futures trading. Anonymity of futures trading allows the possibility of asymmetric information, which makes the futures market one of the most attractive forms of market organisation. A manipulator may therefore possibly take advantage of the anonymity characteristic of futures trading, and build a huge long futures position and then stand for delivery. Other traders, of course, should take this manipulation probability into consideration when they make futures trading decisions. An appropriate approach to modelling futures manipulation therefore naturally leads to game-theory.

Premised on these views, we develop a simple game-theoretical model of futures manipulation which contains four kinds of traders: a large trader, one representative hedger, a number of market makers and noise traders. Market makers quote futures prices by observing the trading process and reflecting their beliefs on the probability of manipulation in the price they quote. However, they cannot tell how much the large trader is buying

or how much the hedgers are selling. In this model, they are treated to be exogenous.

In this model, noise traders are also seen as participating futures trading for exogenous reasons. The risk averse hedger, who is persuaded to hedge her risk exposure by using the futures market, cannot predict accurately the probability of manipulation, but she must hold some beliefs about this probability before she makes her trading decisions. This prior probability is formed from her previous trading experience (effectively the previous contract delivery processes - we will discuss the information updating in Chapter 3). If this belief is high, the hedger would choose not to trade futures or choose to hedge in the other direction. The result is that market makers quote a higher futures price, thereby inhibiting the manipulator in his attempt to manipulate. The manipulator can also learn it from the trading environment. If the prior market belief is high, he may choose to go short instead of undertaking long manipulation. When this belief is not very high, manipulation can occur with a positive probability. Of course, there are other factors which may also affect the vulnerability of futures markets to manipulation. One of the most important factors is the delivery market characteristics, especially the availability of additional deliverable stocks. If additional deliverable stocks are available without much additional costs, manipulation may occur with a lower probability. Thus this model predicts that if the marginal cost of delivery at delivery point is sufficiently high, and there is less than perfect information for other traders on the presence of a manipulator, futures manipulation can occur in equilibrium. Manipulation discourages the hedger's use of futures markets, increases the equilibrium futures prices, and makes futures prices biased estimates of the future cash prices from the point view of all market participants except the market makers. In this way, the economic functions of futures markets are impaired.

The rest of this chapter is organized as follows. In section 2.2, we begin with a description of the structure of the market, the model setup and the equilibrium concept. Section 2.3 characterises the equilibria. Section 2.4 discusses some important issues related to this model and possible extensions. In section 2.5, we analyse traders' behaviour

in this model and some policy implications on futures regulation. A brief conclusion is provided in the final section.

## 2.2 Structure of the Model

### 2.2.1 The market structure

We consider a one-period model with two dates: date 1 and date 2. On date 1, traders negotiate a futures contract which expires on date 2. The commodity futures contract is settled by delivery. Traders may therefore exit their positions on date 2 either via offsetting their positions or by delivery.

Let there be four classes of traders: one large trader, one representative hedger, a number of market makers, and noise traders. The large trader has market power. This game is played between the large trader and the hedger. They trade futures on date 1 strategically. The large trader acquires a futures position on date 1, while the hedger hedges her total exposure  $Z$  in the futures market. Following standard market microstructure literature, for example, Kyle (1984, 1985), Glosten and Milgrom (1985), Foster and Viswanathan (1996), etc., market makers are treated to be exogenous, and are modeled to trade in such a way that the expected profits of acquiring a futures position at market-clearing prices, then liquidating it later through trade or through delivery, are zero. They are assumed to be competitive, but we do not specify why they should be competitive. It may be that they must compete for the right to conduct transactions each other as well as with floor traders in the same contract on the exchange. Noise traders trade randomly an amount of  $\varsigma$  which is normally distributed with mean 0 and variance  $\sigma_\varsigma^2$ . The market we are modelling involves no transaction costs, and all orders are market orders. Trading is modelled and structured to give the flavor of continuous auctions in Kyle (1985), although we concentrate on a one-shot auction. Trade occurs according to the following events. On date 1, the large trader and the hedger simultaneously submit market orders according to information available to them, and market makers,

after observing the aggregate order flows, immediately quote a futures price and trade necessary positions to clear the market. On date 2, all positions are settled through offsetting or by delivery.

Deliverable stocks on date 2 is determined by the supply and demand conditions of the commodity at the delivery point, denoted by  $x(\varepsilon)$ , where  $\varepsilon$  denotes the supply and demand disturbance which is assumed to be normally distributed with mean 0 and variance  $\sigma_\varepsilon^2$ . On date 1, traders do not necessarily observe  $\varepsilon$ , but they know the distribution of  $\varepsilon$ . The large trader does not necessarily hold any fraction of deliverable stocks. The cash price  $p(x(\varepsilon))$  on date 2 is determined jointly by the commodity demand and supply conditions and the amount of deliverable stocks, where  $\frac{\partial p(x(\varepsilon))}{\partial x(\varepsilon)} < 0$ . The marginal cost of increasing deliverable stocks to  $X(\varepsilon) > x(\varepsilon)$  equals  $MC(X(\varepsilon))$ , where  $MC(X(\varepsilon)) > 0$ , and  $\frac{\partial MC(X(\varepsilon))}{\partial X(\varepsilon)} > 0$ . The cash market structure can be best understood by assuming that there are two cash markets: the cash market for normal deliverable stocks at delivery point and the cash market for transforming non-deliverable goods into deliverable goods. The first cash market establishes the cash price for the quantity of delivery up to  $x(\varepsilon)$ , while the second cash market establishes the marginal costs of bring additional deliverable stocks for the amount of delivery exceeding  $x(\varepsilon)$ . We define  $P(X(\varepsilon))$  the marginal cost of delivery for the shorts, where  $P(X(\varepsilon)) = p(x(\varepsilon)) + MC(X(\varepsilon))$ , and  $\frac{\partial P(X(\varepsilon))}{\partial X(\varepsilon)} > 0$ . The marginal cost of delivery for the shorts includes the price and transaction costs the shorts must pay to acquire the commodity, costs of transport it to the delivery point and costs involved in grading to ensure that its quality meets the contract specifications. It increasingly rises with the amount of excess demand for delivery, but the marginal cost of delivery is assumed to finite since it is always feasible to bring additional stocks to delivery point at finite costs in actual futures markets, such that  $0 < P(X(\varepsilon)) < +\infty$ .

The anonymity and noise trading in futures markets facilitate the possibility that the large trader can acquire a long futures position which exceeds the deliverable stocks on date 2, which is, however, not disclosed with certainty to other traders at date 1. The large trader may demand or threaten to demand a delivery of  $X(\varepsilon) > x(\varepsilon)$ , and therefore

he can close out that part of his futures position which exceeds  $x(\varepsilon)$  at the marginal cost of delivery. Under these circumstances, the hedger who normally shorts in futures market, must pay the marginal cost of delivery to meet her contractual obligations on the positions she has not been able to close out. As an atomistic short, she is indeed willing to pay the marginal cost of delivery to liquidate her futures positions due to the characteristic of imperfectly matched hedging at most except for the part of  $x(\varepsilon)$ . This implies that the large trader could profitably squeeze the shorts.

We take the “burying the corpse” effects into consideration. The large trader expects to take delivery of  $X(\varepsilon)$  on date 2 and sells it on the cash market at the post-delivery price which is usually lower than the expected competitive price  $p(x(\varepsilon))$ . But the post-delivery price depends on the market demand and supply conditions prevailing at that time, the size of the delivery, and the demand and supply elasticities of the commodity. It is possible for the large trader to exploit the supply elasticity to keep the post-delivery price as high as possible for a longer period of time. We try to avoid this complication here, and assume the post-delivery price immediately after delivery is the competitive price  $p(x(\varepsilon))$ . The “burying the corpse” effect implies that manipulation is not invariably profitable, although almost all large trader’s long futures positions exceeding  $x(\varepsilon)$  can trigger the occurrence of manipulation. When a trader takes delivery of  $X(\varepsilon) > x(\varepsilon)$ , stocks in the delivery rise and post-delivery cash price in the market falls due to the inflation in stocks. In order to make manipulation profitable, two necessary conditions must hold: firstly, the large trader must acquire some minimum futures position  $Q_{min} > x(\varepsilon)$ , so he can liquidate sufficient futures positions at the marginal cost of delivery  $P(X(\varepsilon))$ , and make profits even after deducting the losses from burying the corpse; and secondly, he must be able to acquire some futures positions at sufficiently low price, which requires that the manipulative initiative is not disclosed at the beginning. Otherwise, he could only accumulate futures positions at or close to the marginal cost of delivery. Therefore, the large trader’s strategies are twofold:

Firstly, given his futures position, the large trader must decide the optimal delivery



$X(\varepsilon)$  he is going to take, not only in order to bid up the marginal cost of delivery sufficiently high to achieve a high revenue from selling parts of his futures position, but also to ensure that the revenue by selling futures contracts exceeds the losses by sales of the delivery stocks at the post-delivery price which is lower than the marginal cost of delivery. Thus, when the trader buys  $Q$  futures contracts at date 1, he chooses the optimal amount of delivery to maximise his expected revenue.

We assume that the expected cash price on date 2 has a two-point distribution, which equals either to the marginal cost of delivery  $P(X(\varepsilon))$  when there is a manipulation, or to the competitive price  $p(x(\varepsilon))$  when there is no manipulation. For simplicity, we write the expected values of the cash prices on date 2 as  $P(\cdot)$  and  $p(\cdot)$  respectively, and the expected values for the normal deliverable stocks and excess deliverable stocks at date 2 as  $X$  and  $x$  respectively hereinafter. Let  $Y(X)$  denote the trader's revenue, the large trader's expected revenue can be written as:

$$E[Y(X)] = (Q - X)P(\cdot) + p(\cdot)X \quad (2.1)$$

The first term on the RHS is the trader's expected revenue from settling his futures contracts by offsetting, while the second term is the expected revenues from sales of the stocks delivered to him at the competitive market price. Maximisation of (2.1) defines an implicit function  $X(Q)$ , which is the optimal value of delivery, given the trader's futures position choice, his expected delivery price and post delivery price prevailing at date 2, and  $\frac{\partial X(Q)}{\partial Q} < 0$ .

Secondly, the large trader chooses his futures positions strategically to maximise his expected profits. We will defer consideration of this problem to the next section.

### 2.2.2 Information sets and payoff functions

All traders have access equally to the same information about the cash market and supply disturbance  $\varepsilon$  as of date 1, and they are aware that the expected marginal cost of making

delivery is  $P(.) > p(.)$  and  $\frac{\partial P(.)}{\partial X} > 0$ , if  $X > x$ . Each player knows his/her own payoff function, the market makers' pricing function, and expected delivery stocks  $x$  at date 2 (without manipulation). Each trader is aware of the distribution of noise trading as well.

We assume the hedger has incomplete information about the large trader's type which determines the large trader's payoff function, but the large trader knows the hedger's type, and therefore her payoff function. The large trader's types are related to the ultimate cash market demand conditions. The large trader's types corresponding to the ultimate cash prices are two: type I ( $T_1$ ) and type II ( $T_2$ ). Formally, the large trader's type space is  $T_i = \{T_1, T_2\}$ . We can interpret this as stating that the type I ( $T_1$ ) manipulates the market by taking delivery of a quantity which exceeds the competitive level of deliverable stocks on date 2 (we call the type I trader the manipulator hereinafter), while the type II ( $T_2$ ) speculates (we call the type II trader the speculator). The hedger's type space is  $T = \{T\}$ . The hedger and market makers do not know whether the large trader belongs to  $T_1$  or  $T_2$ , but they hold a prior probability  $q$  that the large trader is the type I, where  $q = \Pr(T_i = T_1) = 1 - \Pr(T_i = T_2)$ . The prior probability of manipulation arises from previous delivery processes, trading records and experience, and effectively it is conditional on previous delivery prices. The large trader knows that the hedger and market makers hold this prior.

We assume that the different cost functions associated with manipulation justify the two types of large trader. The type I large trader has a low cost of manipulation, while the type II large trader has a high cost of manipulation. The costs of manipulation could be expected civil penalties, 'psychic' costs associated with lawbreaking, the costs of *ex post* prosecution, forbidden access to futures markets, and bankruptcy costs due to failed manipulation, etc. The low cost of manipulation for the type I trader may be due to his sounder financial resources, easier accessibility to external finance, less regulatory constraints, scopes of business involved, for example, a commercial trader's large futures position is easier to be justified than that of the trading arm of a bank, etc.

Following well established tradition, the hedger is assumed to be risk averse, and

she is seen as buying insurance in futures markets to hedge against price risk. The large trader is normally assumed to be risk neutral (see, for example, Kyle (1984) and the major case in Newbery (1984), and large literature on informed trading). His risk neutrality may be approximately justified by assuming that the large trader's wealth is sufficiently large and his portfolios are well diversified. In addition, the market makers' pricing function is nonstochastic and increases monotonically with the net long order flows. Given the pricing function and the optimal delivery the large trader has to take (for type I, the optimal delivery is  $X^*$ ; for type II, 0, as determined by equation (2.1)), he chooses futures positions  $Q_i$ , where  $i = 1, 2$ , representing type I and type II respectively, in order to maximise his expected profits. Simultaneously, given the market makers' pricing function and the prior probability of the large trader's type, the hedger chooses futures position  $H$  to maximise her expected utilities.  $Q_i$  and  $H$  are real numbers. A positive quantity of  $Q_i$  represents purchases, and a negative quantity denotes sales; while a positive quantity of  $H$  denotes sales, and a negative quantity denotes purchases.

Let  $E[\Pi(Q_i, H)]$  represent the large trader's expected profit function as a function of all the players' strategy choices and of his types,

$$E[\Pi(Q_i, H)] = Q_i[p(.) - f] + (Q_i - X)[P(.) - p(.)] - V_i$$

where  $f$  is the futures price on date 1,  $V_i$  is the costs associated with manipulation for the large trader,  $i = 1, 2$ , representing the two types of the large trader. Without loss of generality, we assume that  $V_1 = 0$  and  $V_2 > 0$ .

Assume that  $\frac{\partial E[\Pi(Q_i, H^*)]}{\partial Q_i} > 0$  and  $\frac{\partial \partial E[\Pi(Q_i, H^*)]}{\partial \partial Q_i} < 0$ , which will be demonstrated to be true given the monotonicity assumption of the market makers' pricing function.

More explicitly, for the type I large trader, the expected profit function is:

$$E[\Pi(Q_1, H)] = [Q_1 - X(Q_1)]P(.) + X(Q_1)p(.) - Q_1f \quad (2.2)$$

The first term on the RHS of (2.2) is the expected profits from settling futures con-

tracts through offsetting; the second term is the expected values for sales of delivery *ex post*; and the last term is the costs of acquiring futures positions.

For the type II trader, we assume that the physical costs ( $V_2$ ) he expects is so large if he attempts to manipulate that his maximum expected profits from manipulation is strictly less than the maximum expected profits from speculation which forces him to pursue an objective function that differs from that of the type I's. Therefore, his expected profit function is:

$$E[\Pi(Q_2, H)] = Q_2[p(.) - f] \quad (2.3)$$

If  $V_2 > [[Q_2^* - X^*(Q_2^*)]P(.) + X^*(Q_2^*)p(.) - Q_2^*f] - Q_2'[p(.) - f]$ , i.e., the expected physical costs of manipulation for the type II trader exceed the potential benefits, the type II trader's objective function is justified.

Assume that the hedger has a mean-variance utility function. Let  $U(\Pi(H, Q_i))$  denote the utility function for the hedger,  $H$  the total futures position by the hedger,  $Z$  the aggregate risk exposure and  $A$  the absolute risk aversion. As the hedger's beliefs that the large trader is the type I are  $q$ , therefore the hedger's expected delivery price must be  $qP(.) + (1 - q)p(.)$ , and her expected payoff function can be written as:

$$\begin{aligned} E[U(\Pi(H, Q_i))] &= Z[qP(.) + (1 - q)p(.)] + H(f - [qP(.) + (1 - q)p(.)]) \\ &\quad - \frac{1}{2}AVar(\Pi(H, Q_i)) \end{aligned} \quad (2.4)$$

Similarly, given the optimal position taken by the large trader and the market makers' futures pricing function,  $\frac{\partial E[U(\Pi(H, Q_i^*))]}{\partial H} > 0$ , and  $\frac{\partial \partial E[U(\Pi(H, Q_i^*))]}{\partial \partial H} < 0$ .

Given their prior beliefs, market makers quote a futures price which is the conditional expected cash price on date 2, and the expectations are conditional on the aggregate positions traded by the large trader, the hedger and noise traders and on the information about  $\varepsilon$  on date 1. Let  $\Delta$  be the net long position traded by the large trader, the hedger and noise traders, i.e.,  $\Delta = Q_i - H + \varsigma$ , where  $\varsigma$  is the net long position by noise traders.

Therefore the futures price  $f$  at date 1 satisfies:

$$f = f(\Delta, q) = E(\tilde{p} \mid q, \Delta) \quad (2.5)$$

where  $\tilde{p}$  is the cash price prevailing at date 2.

Given their prior, after they observe the aggregate quantities traded by the large trader, the hedger and noise traders, the market makers' posterior probability of manipulation is:

$$\Phi(Q_i - H + \varsigma)$$

The posterior probability of manipulation is the probability that the large trader's futures position exceeds the normal deliverable stocks, given the market makers' prior and additional information from the net order flow. Mathematically,  $\Phi(Q_i - H + \varsigma) = \Pr(Q_1 > x \mid q, \Delta = Q_i - H + \varsigma) = \Pr(\theta^* \leq Q_i - H + \varsigma)$ , where  $\theta^*$  is market makers' optimal value which is not known to all other players, but assume that it's distribution is known to all market players.  $\phi(Q_i - H + \varsigma)$  is the density function. Its probability distribution has following properties:  $\Phi'(Q_i - H + \varsigma) > 0$  and  $\Phi''(Q_i - H + \varsigma) \geq 0$ . The probability of manipulation increases monotonically with the net long positions traded.

Assume that the market makers' futures pricing function takes linear form and depends on the posterior probability of manipulation, the expected competitive price and manipulated price at date 2. Thus the futures price becomes:

$$f(\Delta, q) = \begin{cases} p(.) & \text{if } \Phi(Q_i - H + \varsigma) = 0 \\ p(.) + \Phi(Q_i - H + \varsigma)[P(.) - p(.)] & \text{if } 0 < \Phi(Q_i - H + \varsigma) < 1 \end{cases} \quad (2.6)$$

### 2.2.3 Extensive form representation

In terms of the extensive form representation of the manipulation game, there are 3 active players: 1 large trader, 1 representative hedger plus nature. Nature moves first and determines the realisation of the large trader's type. The large trader observes

$T_i = \{T_1, T_2\}$ . The hedger and market makers have a prior belief ( $q$ ) on the large trader's type, and  $q = \Pr(T_i = T_1) = 1 - \Pr(T_i = T_2)$ . This is a common knowledge among all traders.

In any extensive form game, a player's strategy is a specification of the action he/she will take in any information set, i.e., the player's actions at any point can depend only on what he/she knows at that point. Here, the information set for the large trader is defined by the realised values of the types,  $T_i = \{T_1, T_2\}$  (given by Nature's move) and those for the hedger's by a prior belief  $q = \Pr(T_i = T_1)$ . Given market makers' pricing function, the large trader's actions and the hedger's actions are their futures position choices  $Q_i, H$  respectively. The action space for the large trader is defined as  $a_m \in A_m = \{Q_i \in s : -\infty < Q_i < +\infty\}$ , and the action space for the hedger is defined as  $a_h \in A_h = \{H \in t : -\infty < H < +\infty\}$ , where  $Q_i$  and  $H$  are real numbers. Thus a (pure) strategy for the large trader is a map  $s$  from its possible expected cash market demand conditions into possible choices of  $Q_i$  and a (pure) strategy for the hedger is a map  $t$  from  $\mathfrak{R}$  giving her choices of  $H$  for her prior beliefs.

The equilibrium concept used here is the static Bayesian Nash equilibrium. If the large trader contemplates changing his strategy, he assumes that the hedger does not change hers in response, and vice versa. A pair of strategies constitute an equilibrium if each player maximises his/her expected payoffs, given that the other is using his/her specific strategy. Thus given market makers' futures pricing function, a pair of  $(Q_i^*, H^*)$  is a static Bayesian Nash equilibrium if and only if:

- The large trader's strategy  $Q_i^*$  is optimal given the hedger's strategies for any  $i \in \{1, 2\}$ , and any  $s_i \in s$  :

$$E[\Pi(Q_i^*, H^*)] \geq E[\Pi(Q_i, H^*)]$$

- The hedger's strategy  $H^*$  is optimal given her prior assessment  $\Pr(T_i = T_1) = q$ ,  $q \in [0, 1]$ , and the large trader's strategies, for any  $t_i \in t$ :

$$E[U(\Pi(H^*, Q_i^*))] \geq E[U(\Pi(H, Q_i^*))]$$

According to this equilibrium concept, the large trader maximises his expected profits taking into account the effect that a change in his trading has on futures price. One important point worth mentioning is that the large trader must never be induced to trade in such a way that his type is revealed to market makers on date 1 with certainty. The reason is obvious. If he trades futures in the way that market makers can infer his type with probability 1, he could neither profitably manipulate nor speculate. Suppose that the market makers can infer from order flow that he is the type II, then the equilibrium futures price is  $p(\cdot)$ , and the large trader's strategy must be no trading; accordingly, if market makers can infer that he is the type I, they will quote futures price as  $P(\cdot)$ , then the large trader will lose money with probability 1. These arguments will be developed into more details in the next section.

## 2.3 Equilibria Characterisation

Given the framework described above, we can compute a pair  $(Q_i^*, H^*)$  which will constitute an equilibrium. Naturally, the large trader may want to choose a different (presumably lower or even negative (short)) quantity of futures position if his expected price at delivery is low (without manipulation) than if it is high (with manipulation). The hedger, for her part, should anticipate that the large trader may tailor his position choices to his private information on his type, and therefore cash market demand conditions prevailing at delivery period in this way.

Given the market makers' futures pricing function (equation (2.6)), if the large trader is the type I, he will jointly choose  $Q_1^*$  and  $X^*(Q_1)$  to solve his optimisation problems (following equation (2.1) and (2.2)) to maximise his expected profits, i.e.,

$$\max E[Y(X)] = \max \{(Q_1 - X(Q_1))[P(\cdot)] + X(Q_1)[p(\cdot)]\} \quad (2.7)$$

$$\max E[\Pi(Q_1, H^*)] = \max\{[Q_1 - X(Q_1)]P(.) + X(Q_1)p(.) - Q_1f\} \quad (2.8)$$

Equation (2.7) states that the large trader maximises his revenue by choosing the optimal delivery given his futures position; while equation (2.8) says that he maximises his expected profits by choosing his optimal futures position given his optimal delivery decision. Assume that there is a linear relationship between the marginal cost of delivery and the quantity of delivery that the large trader demands. The (expected) marginal cost of delivery on the delivery market can be written as:

$$P(.) = \omega + \gamma X \quad (2.9)$$

where  $\gamma$  is the inverse of the appropriately scaled supply elasticity into exchange warehouses. The higher  $\gamma$ , the less elastic is the delivery supply into the exchange warehouses, and vice versa.

Given the manipulator's choice of  $Q_1$  and the expected cash market price (without manipulation)  $p(.)$ , the first order condition of (2.7) with respect to  $X$  yields:

$$X = \frac{p(.) - \omega + \gamma Q_1}{2\gamma} \quad (2.10)$$

Given the manipulator's optimal futures position, he has to take more delivery when the delivery supply is more elastic at the delivery market (i.e.,  $\gamma$  is lower); on the other hand, he can take less delivery as the supply elasticity declines. Substitute equation (2.10) to (2.9), the marginal cost of delivery is:

$$P(.) = \frac{\omega + p(.) + \gamma Q_1}{2} \quad (2.11)$$

Equation (2.11) states that, given the manipulator's optimal futures position, the more inelastic the delivery supply (i.e., the higher  $\gamma$ ), the higher is the marginal cost of delivery, which creates more advantage for the manipulator. Substitute equation (2.10)



and (2.11) back to equation (2.8), then equation (2.8) becomes:

$$\begin{aligned} \max E^m[\Pi(Q_1, H^*)] &= \max\{Q_1 - (\frac{p(.) - \omega + \gamma Q_1}{2\gamma})\}(\frac{\omega + p(.) + \gamma Q_1}{2}) \\ &\quad + (\frac{p(.) - \omega + \gamma Q_1}{2\gamma})p(.) - Q_1 f \end{aligned} \quad (2.12)$$

where

$$f(\Delta, q) = p(.) + \Phi(Q_i - H + \varsigma)(\frac{\omega - p(.) + \gamma Q_1}{2})$$

As a first step to characterize the equilibrium, we claim that there is some critical value of market beliefs, if the market beliefs on the probability of manipulation exceed this critical level, manipulation will not occur in equilibrium with probability 1.

**Proposition 1** *There exists a unique  $q^*$ , for any  $q \geq q^*$ ,  $H^* \leq 0$  and  $E[U(\Pi(H^*, Q_i^*))] \geq U_0$  with probability 1 (where  $U_0$  is the hedger's reservation utility and  $U_0 > 0$ );  $Q_i^* \leq 0$  and  $E[\Pi(Q_i^*, H^*)] \geq 0$  with probability 1.*

**Proof.** Proposition 1 states that there is a critical value for market beliefs regarding the large trader's type, such that for any other prior belief which is up to or which exceeds this value, the hedger's optimal strategy is to either stay out of futures trading (when  $q = q^*$ ), or to go short (when  $q > q^*$ ). Under these circumstances, manipulation would never be an optimal strategy for the large trader.

To prove this, let's look at the hedger's problem first. We wish to demonstrate this critical value exists.

Returning to equation (2.4), the hedger's expected price given her prior is:

$$E^h(\tilde{p}) = \frac{2p(.) - qp(.) + \omega q + \gamma q Q_1^*}{2}$$

Her conditional expected revenue is:

$$E^h[\Pi(H, Q_i^*)] = Z(\frac{2p(.) - qp(.) + q\omega + \gamma q Q_1^*}{2}) +$$

$$H\left(\frac{\omega - p(.) + \gamma Q_1^*}{2}\right)[\Phi(Q_i - H + \varsigma) - q]$$

The variance of the first term is:  $Z^2(\frac{2-q}{2})^2\sigma_\epsilon^2$ , the variance of the second term is:  $\frac{\sigma_\epsilon^2\sigma_\phi^2 + q^2\sigma_\epsilon^2}{4}H^2$ , and the covariance of the first and the second term is:  $-\frac{q(2-q)}{4}[\Phi(Q_i - H + \varsigma) - q]\sigma_\epsilon^2ZH$ . Therefore, the variance of the hedger's revenue becomes:

$$\begin{aligned} Var(\Pi(H, Q_i^*)) &= \left(\frac{2-q}{2}\right)^2\sigma_\epsilon^2Z^2 - \frac{q(2-q)}{4}[\Phi(Q_i - H + \varsigma) - q]\sigma_\epsilon^2ZH \\ &\quad + \frac{\sigma_\epsilon^2\sigma_\phi^2 + q^2\sigma_\epsilon^2}{4}H^2 \end{aligned}$$

where  $\sigma_\phi^2$  is the variance of the probability distribution of market makers' pricing function.

We assume that this probability distribution is independent of cash price movement.

Substitute these values back into equation (2.4), equation (2.4) becomes:

$$\begin{aligned} E[U(\Pi(H, Q_i^*))] &= Z\left(\frac{2p(.) - qp(.) + q\omega + \gamma qQ_1}{2}\right) \\ &\quad + H\left(\frac{\omega - p(.) + \gamma Q_1}{2}\right)[\Phi(Q_i - H + \varsigma) - q] \\ &\quad - \frac{1}{2}A\left[\left(\frac{2-q}{2}\right)^2\sigma_\epsilon^2Z^2 - \frac{(2-q)}{4}[\Phi(Q_i - H + \varsigma) - q]\sigma_\epsilon^2ZH \right. \\ &\quad \left. + \frac{\sigma_\epsilon^2\sigma_\phi^2 + q^2\sigma_\epsilon^2}{4}H^2\right] \end{aligned} \quad (2.13)$$

Maximisation of equation (2.13) given their prior beliefs regarding the large trader's type becomes the hedger's optimisation problem. The first order condition of equation (2.13) with respect to  $H$  yields:

$$\begin{aligned} 0 &= \left(\frac{\omega - p(.) + \gamma Q_1}{2}\right)[\Phi(Q_i - H + \varsigma) - q] - \left(\frac{\omega - p(.) + \gamma Q_1}{2}\right)\phi(Q_i - H + \varsigma)H \\ &\quad + \frac{A}{2}Z\sigma_\epsilon^2\left[\frac{q(2-q)}{4}(\Phi(Q_i - H + \varsigma) - q) - \frac{(2-q)}{4}\phi(Q_i - H + \varsigma)\right] \\ &\quad - \frac{A}{4}(q^2\sigma_\epsilon^2 + \sigma_\epsilon^2\sigma_\phi^2)H \end{aligned} \quad (2.14)$$

From equation (2.14), we can solve out  $H^*$  as a function of  $Q_i^*, q, \sigma_\epsilon^2, \sigma_\phi^2, \sigma_\varsigma^2, \gamma, Z$  and

$p(\cdot)$ . Note that  $Q_i^* = qQ_1^* + (1 - q)Q_2^*$ . Assume that the function form takes  $\psi_2(\cdot)$ . Mathematically,  $H^*$  can be expressed as:

$$H^* = \psi_2(Q_i^*, q, \sigma_\varepsilon^2, \sigma_\phi^2, \sigma_\varsigma^2, \gamma, Z) \quad (2.15)$$

Since the hedger must have some reservation utility ( $U_0 > 0$ ). For the hedger to participate futures trading, she must make sure that her expected utility is not less than her reservation level. Substitute equation (2.15) to equation (2.13), and let equation (2.13) equal  $U_0$ . It is not hard to solve out the critical value  $q^*$ . For any  $q \geq q^*$ , any short position the hedger takes, the hedger's expected utility must not be greater than her reservation level, i.e.,  $E[U(\Pi(H^*, Q_i^*))] \leq U_0$ . For the hedger's expected utility not to be less than her minimum level, she must choose to stay out of futures trading when  $q = q^*$ , or to go long when  $q > q^*$ .

For the type II large trader, his expected cash price is  $p(\cdot)$ , while the equilibrium futures price is  $p(\cdot) + \Phi(Q_i^* - H^* + \varsigma)(\frac{\omega - p(\cdot) + \gamma Q_1}{2})$ , which is greater than  $p(\cdot)$ . He therefore will definitely go short and make positive expected profits.

For the manipulator not to lose money, the optimal strategy is either to stay out of futures trading or to go short. To see why, (to be contradicted) consider if he chooses  $Q_1 > x$  to enter the market, market makers would infer from the order flow that  $T_i = T_1$ . Since the hedger trades no futures or goes long in this case, then market order flow exhibits uniquely long, and large long order flow can be identified with certainty. Market makers would set  $f(q, \Delta) = P(\cdot)$ , making the manipulation unprofitable, hence this cannot be an equilibrium. Clearly, for the manipulator not to lose money when  $q \geq q^*$ , it must be the case that either  $Q_1 = 0$  and  $E[\Pi(Q_1, H^*)] = 0$ , or  $Q_1 < 0$  and  $E[\Pi(Q_1, H^*)] > 0$ . ■

The intuition behind proposition 1 is simple. The hedger is risk averse, and is preparing to forgo some revenues in exchange for transferring some risks to other traders. But her risk aversion is limited, whenever she expects to reach the balance between the losses

on the expected revenue and gains on the expected utility, she will decide not to participate futures trading or to hedge in the other direction. Under this circumstance, the manipulator's large long order would be identified with certainty by market makers, hence he cannot profitably manipulate. Proposition 1 implies that there are occasions on which the market shuts down, which is similar as the lemons problem of Akerlof (1970). When the prior probability of manipulation is sufficiently high that the hedger has no incentives in participating futures hedging, then there are no profitable opportunities for the large traders as well. The market will recover when the hedger and market makers are sure that the type I trader has left the market to some extent. However, in the real world, it is rare that markets shut down entirely even if a manipulator has entered the market, since it is not possible for the hedger and market makers to infer accurately from available information the presence of manipulator due to noise trading.

Proposition 1 demonstrates that manipulation does not occur in equilibrium when  $q \geq q^*$ . The next proposition shows, under certain circumstances, manipulation occurs in equilibrium with a positive probability. Given the market makers' non-stochastic pricing function, an equilibrium always exists and the equilibrium is unique. In equilibrium, both the large trader and the hedger trade a unique optimal position, there exists a unique probability that manipulation occurs and a unique equilibrium futures pricing process.

**Proposition 2** *If  $0 < q < q^*$ , there exists an equilibrium. The equilibrium, classified according to the values of the market makers' conditional probability, is necessary to fall into one of the following three types:*

1.  $\Phi(Q_i^* - H^* + \varsigma) = 0$ . Manipulation occurs with probability zero, the equilibrium futures price is  $p(\cdot)$ .  $Q_i^* = 0, H^* = -(\frac{2-q}{2q})Z + \frac{4(P(\cdot)-p(\cdot))}{Aq\sigma_\epsilon^2}$ .
2.  $\Phi(Q_i^* - H^* + \varsigma) = q$ . Manipulation occurs with probability  $q$ , the equilibrium futures price is  $(1-q)p(\cdot) + qP(\cdot)$ .  $Q_1^* = \frac{(1-q)(p(\cdot)-\omega)}{(1-2q)\gamma}$ ,  $Q_2^* = 0, H^* = Z$ .
3.  $0 < \Phi(Q_i^* - H^* + \varsigma) < 1$ . Manipulation occurs with probability  $\Phi(Q_i^* - H^* + \varsigma)$ , the equilibrium futures price is  $p(\cdot) + \Phi(Q_i^* - H^* + \varsigma)[P(\cdot) - p(\cdot)]$ . There exists a unique  $Q_i^*$  and  $H^*$  such that  $E[\Pi(Q_i^*, H^*)] \geq E[\Pi(Q_i, H^*)]$ , and  $E[U(\Pi(H^*, Q_i^*))] \geq E[U(\Pi(H, Q_i^*))]$ .

**Proof.** *Case 1:*  $\Phi(Q_i^* - H^* + \varsigma) = 0$ . This is the case where no suspected manipulation is identified from the order flow by market makers, and the market makers' futures quote is  $p(\cdot)$ . Let's look at the hedger's problem first.

For the hedger, her conditional expected cash price at date 2 given her prior beliefs is

$$\frac{2p(\cdot) - qp(\cdot) + q\omega + \gamma qQ_1}{2}$$

Her conditional revenue is

$$\begin{aligned} E[\Pi(H, Q_i^*)] &= Z\left(\frac{2p(\cdot) - qp(\cdot) + q\omega + \gamma qQ_1}{2}\right) \\ &\quad + H\left[p(\cdot) - \left(\frac{2p(\cdot) - qp(\cdot) + q\omega + \gamma qQ_1}{2}\right)\right] \end{aligned}$$

The variance of the first term of the above equation is  $Z^2(\frac{2-q}{2})^2\sigma_\varepsilon^2$ , the variance of the second term is  $H^2(\frac{q}{2})^2\sigma_\varepsilon^2$ , and the covariance between the first and the second term is  $ZH(\frac{2-q}{2})^2q\sigma_\varepsilon^2$ . Following equation (2.4), the hedger's optimisation problem becomes:

$$\begin{aligned} \max E[U(\Pi(H, Q_i^*))] &= \max\left\{Z\left(\frac{2p(\cdot) - qp(\cdot) + q\omega + \gamma qQ_1}{2}\right) \right. \\ &\quad \left. + H\left[p(\cdot) - \left(\frac{2p(\cdot) - qp(\cdot) + q\omega + \gamma qQ_1}{2}\right)\right] \right. \\ &\quad \left. - \frac{1}{2}A\left[Z^2\left(\frac{2-q}{2}\right)^2\sigma_\varepsilon^2 + ZH\left(\frac{2-q}{2}\right)^2q\sigma_\varepsilon^2 + H^2\left(\frac{q}{2}\right)^2\sigma_\varepsilon^2\right]\right\} \end{aligned} \quad (2.16)$$

The first order condition of equation (2.16) with respect to  $H$  yields the optimal futures position for the hedger:

$$H^* = -\left(\frac{2-q}{2q}\right)Z + \frac{2(\omega - p(\cdot) + \gamma Q_1)}{Aq\sigma_\varepsilon^2} \quad (2.17)$$

Note that  $\omega - p(\cdot) + \gamma Q_1$  in equation (2.17) is  $2[P(\cdot) - p(\cdot)]$  (following equation (2.11)), equation (2.17) then becomes:

$$H^* = -\left(\frac{2-q}{2q}\right)Z + \frac{4(P(\cdot) - p(\cdot))}{Aq\sigma_\varepsilon^2} \quad (2.18)$$

Equation (2.18) states that the hedger will go long, but her long position will be reduced with the increase of the level of risk aversion and the variance of supply shocks, but increase with the differences between the manipulated price and the competitive price.

For the type II large trader, his expected future cash price is the same as the market makers' quoted price, from equation (2.3), and his optimal position should be zero, i.e.,

$$Q_2^* = 0 \quad (2.19)$$

We claim that the optimal strategy for the type I trader (the manipulator) is to stay out of futures trading. To prove this claim, we assume that the type I trader enters a market by submitting  $Q_1 > x$ . Following equation (2.2), his optimisation problem becomes:

$$\begin{aligned} \max E[\Pi(Q_1, H^*)] = & \max \left\{ \left[ Q_1 - \left( \frac{p(.) - \omega + \gamma Q_1}{2\gamma} \right) \right] \left( \frac{\omega + p(.) + \gamma Q_1}{2} \right) \right. \\ & \left. + \left( \frac{p(.) - \omega + \gamma Q_1}{2\gamma} \right) p(.) - Q_1 p(.) \right\} \end{aligned} \quad (2.20)$$

The first order condition of equation (2.20) with respect to  $Q_1$  yields:

$$\left[ Q_1 - \left( \frac{p(.) - \omega + \gamma Q_1}{2\gamma} \right) \right] \left( \frac{\gamma}{2} \right) + \frac{1}{2} \left( \frac{\omega + p(.) + \gamma Q_1}{2} \right) - \frac{1}{2} p(.) = 0 \quad (2.21)$$

Because the trader's cost of acquiring futures positions is fixed in this case, if he can acquire any positions exceeding  $Q_1^{\min}$  which can be solved out from equation (2.21), he will make positive expected profits. This is,

$$Q_1^{\min} = \frac{p(.) - \omega}{\gamma} \text{ or } Q_1^{\min} = X \quad (2.22)$$

From equation (2.22), as an expected profit maximiser, he will choose an arbitrarily large long order into the market with probability 1, and therefore, his strategy would be

found out by the market makers with certainty. Since the hedger will go long in this case, market makers cannot be fooled in front of unique large long order flow, they therefore will quote futures price as  $P(\cdot)$ , thus making manipulation unprofitable. Hence, it is contradicted by the supposition that trader's manipulative incentive is not disclosed to market makers, and cannot constitute an equilibrium. On the other hand, he cannot make profits by shorting futures either, since he can only sell short at the equilibrium futures price  $p(\cdot)$ , which is expected to be the price prevailing at delivery. Under this circumstance, the type I trader had better stay out of futures trading altogether.

*Case 2:*  $\Phi(Q_i^* - H^* + \varsigma) = q$ . This is a special case that the conditional probability is the same as their prior, i.e., there is no further evidence on the presence of the manipulator by market makers from net order flow. In this case, the market makers' futures pricing function is:

$$f(\Delta, q) = \frac{2p(\cdot) - qp(\cdot) + q\omega + \gamma q Q_1}{2}$$

For the type I trader, from equations (2.8), (2.9), and (2.11), his optimisation problem becomes:

$$\begin{aligned} \max E[\Pi(Q_1, H^*)] = & \max \left\{ \left[ Q_1 - \left( \frac{p(\cdot) - \omega + \gamma Q_1}{2\gamma} \right) \right] \left( \frac{\omega + p(\cdot) + \gamma Q_1}{2} \right) \right. \\ & \left. + \left( \frac{p(\cdot) - \omega + \gamma Q_1}{2\gamma} \right) p(\cdot) - Q_1 \left( \frac{2p(\cdot) - qp(\cdot) + q\omega + \gamma q Q_1}{2} \right) \right\} \end{aligned} \quad (2.23)$$

The first order condition of equation (2.23) with respect to  $Q_1$  yields:

$$\frac{\gamma}{2} Q_1 + \frac{\omega - p(\cdot)}{2} + q \left( \frac{p(\cdot) - \omega}{2} \right) - q\gamma Q_1 = 0$$

Rearranging the above equation gives:

$$Q_1^* = \frac{(1 - q)(p(\cdot) - \omega)}{(1 - 2q)\gamma} \quad (2.24)$$

But we argue that there is no equilibrium strategy for the type II trader in this

case. To see why, (to be contradicted) suppose that he chooses futures position  $Q_2$ , his optimisation problem is

$$\max E[\Pi(Q_2, H^*)] = \max \left\{ Q_2[p(\cdot) - (\frac{2p(\cdot) - qp(\cdot) + q\omega + q\gamma Q_1}{2})] \right\} \quad (2.25)$$

Obviously, his expected cash price is less than the equilibrium futures price. As a profit maximiser, he will go short as much as he could, since arbitrarily large short order contradicted the supposition that market makers' conditional probability of manipulation is  $q$ . Hence this cannot be an equilibrium strategy.

We now turn to look at the hedger's optimisation problem.

The hedger's expected price is  $(\frac{2p(\cdot) - qp(\cdot) + q\omega + q\gamma Q_1}{2})$ , because her expected futures price is exactly the equilibrium futures price, she will hedge exactly the amount of her risk exposure  $Z$ .

In this case, the equilibrium clearly hinges on the value of  $\gamma$  and the size of the hedger's risk exposure  $Z$ . If  $\gamma$  and  $Z$  are sufficiently large, the manipulator could still possibly choose  $Q_1^* > x$  to manipulate the market without revealing his type to market makers with certainty. Otherwise, market makers would quote the futures as  $P(\cdot)$  instead of  $p(\cdot) + \Phi(Q_i^* - H^* + \varsigma)[P(\cdot) - p(\cdot)]$ . For a manipulation to occur in equilibrium, we require that either hedging is quite active  $Q_1^* - Z < x$ , or the supply in the delivery market is inelastic to a certain degree. From equation (2.24), the later condition can be represented as:  $\gamma < \frac{(1-q)(p(\cdot) - \omega)}{(1-2q)(x+Z)}$ .

*Case 3:*  $0 < \Phi(Q_i^* - H^* + \varsigma) < 1$ . In this case, we claim that there is a unique strategy for each player to constitute an equilibrium.

Let's look at the type I trader's problem first. Given market makers' pricing function and the hedger's choice of  $H$ , it is not difficult to solve out  $Q_1^*$  as a function of  $H^*$ ,  $\gamma$ ,  $q$ ,  $\sigma_\varsigma^2$  and  $p(\cdot)$ . Assume that the function form takes  $\psi_1(\cdot)$ , then the first order condition of



equation (2.12) with respect to  $Q_1$  gives:

$$0 = \frac{\gamma}{2}Q_1 + \frac{\omega - p(\cdot)}{2} - \Phi(Q_1 - H^* + \varsigma)\left(\frac{\omega - p(\cdot) + \gamma Q_1}{2}\right) - Q_1\left[\phi(Q_1 - H^* + \varsigma)\left(\frac{\omega - p(\cdot) + \gamma Q_1}{2}\right) + \frac{\gamma}{2}\Phi(Q_1 - H^* + \varsigma)\right] \quad (2.26)$$

Solving equation (2.26), we get the optimal quantity of the type I trader's futures position  $Q_1^*$  as a function of  $H^*$ ,  $\gamma$ ,  $q$ ,  $\sigma_\varsigma^2$  and  $p(\cdot)$ . Mathematically, it can be expressed as:

$$Q_1^* = \psi_1(H^*, \gamma, q, p(\cdot), \sigma_\varsigma^2) \quad (2.27)$$

Although  $Q_1^*$  is implicitly expressed in equation (2.27), it is intuitively true that  $\frac{\partial Q_1}{\partial H} > 0$  holding the probability function fixed, and  $\frac{\partial Q_1}{\partial \gamma} < 0$  given that the large trader's expected profits are fixed. The implication is that the more active the hedger trades, the more position can the type I trader acquire without affecting the risk that his type would be revealed, given the market makers' pricing function. While the second inequality implies that the more inelastic the supply of delivery commodities, the less position required for the type I trader to profitably manipulate the market.

For the type II trader, substituting the futures price back to equation (2.3), his optimisation problem becomes:

$$\max E[\Pi(Q_2, H)] = \max[-Q_2\Phi(Q_2 - H^* + \varsigma)\left(\frac{\omega - p(\cdot) + \gamma Q_1}{2}\right)] \quad (2.28)$$

The first order condition of equation (2.28) with respect to  $Q_2$  yields:

$$-\Phi(Q_2 - H^* + \varsigma)\left(\frac{\omega - p(\cdot) + \gamma Q_1}{2}\right) - Q_2\phi(Q_2 - H^* + \varsigma)\left(\frac{\omega - p(\cdot) + \gamma Q_1}{2}\right) = 0 \quad (2.29)$$

Solution to equation (2.29) yields:

$$Q_2^* = -\frac{\Phi(Q_2^* - H^* + \varsigma)}{\phi(Q_2^* - H^* + \varsigma)} \quad (2.30)$$

Since  $\Phi(Q_2^* - H^* + \varsigma) > 0$ , and  $\phi(Q_2^* - H^* + \varsigma) > 0$ , the type II trader's optimal strategy is therefore to go short with futures.

Finally, let's look at the hedger's problem. From proposition 1, we know that given the large trader's optimal strategy and market makers' pricing function, the hedger's optimal choice is given by equation (2.15). We only describe some properties of their optimal decisions here.

Since  $0 < q < q^*$ , from proposition 1 we are sure that  $H^* > 0$ . Although it is tedious to prove, intuitively all the following properties must hold:  $\frac{\partial H}{\partial \gamma} < 0$ ,  $\frac{\partial H}{\partial A} < 0$ ,  $\frac{\partial H}{\partial \sigma_\epsilon^2} < 0$ ,  $\frac{\partial H}{\partial Z} > 0$ . These conditions imply that the inelastic supply of delivery commodities at delivery market, the hedger's risk aversion, and the cash price volatility contribute negatively to the hedger's short positions; while the larger the risk exposure, the larger the short position will she take.

From equations (2.15), (2.27), and (2.30), there are three unknowns, and we can solve them out explicitly. Thus, we get  $Q_1^*, Q_2^*, H^*$ , the optimal position strategies for the type I trader, the type II trader and the hedger respectively. The type I trader will choose  $Q_1^*$  long position to profitably manipulate the market; the type II trader will choose  $Q_2^*$  short position to speculate; and the hedger will choose  $H^*$  to hedge her long risk exposure in cash markets. ■

It is clear from the equilibrium analysis that the probability of manipulation is necessarily not higher than the prior beliefs that the large trader belongs to type I, or strictly, it is not higher than the critical level of the prior beliefs  $q^*$ . However, one needs to be careful in characterizing the large trader's equilibrium strategy, since type I trader can choose type II trader's strategy, if he expects it is more profitable to go short. This is very important when we consider a game with sequential equilibrium, although we are not going to pursue it here. In order to assume  $Q_1^*$  is the type I trader's optimal strategy, we need impose one more restriction. This is that manipulation strategy dominates speculation strategy whenever a market is manipulatable, i.e.,  $E[\Pi(Q_1^*, H^*)] > E[\Pi(Q_2^*, H^*)]$ . Intuitively, it is true when the level of  $q$  is not high.

## 2.4 Discussions

### 2.4.1 How much delivery is optimal in practice

The foregoing presented a simple theoretical model of commodity futures manipulation. It has been shown that when a manipulation is considered by other traders to be very likely, manipulation will not occur in equilibrium. But if a manipulation is not highly expected, and under certain other conditions, manipulation can occur in equilibrium. In equilibrium, the manipulator will take an amount of delivery which exceeds the normal delivery supply.

In practice, usual solution to futures manipulation cases, however, does not involve much delivery. As introduced in Chapter 1, what the manipulator prefers is the higher liquidation price, and taking delivery itself is not the objective of manipulation, but the means to ensure the elevation of futures price at contract maturity in stead. In our model, the manipulator already takes into account the “burying the corpse” effect of a manipulation, and the optimal level of delivery and optimal position are well determined endogenously. The tactics of threatening and bluffing do not appear to be important in contrast to most manipulation cases in the real world. Put it in another way, the large trader is indifferent in taking delivery up to the optimal amount ( $X^*$ ) in our model. But both the long and short have incentives to take or make less delivery indeed, if delivery is costly for both sides. and the manipulator would offer a liquidation price which is less than the marginal cost of delivery to the short. If we consider the large trader’s legal risk for taking huge delivery that he does not want, it is not difficult to understand why he will try to avoid delivery if he can persuade the short to liquidate her position at a premium. One obvious means to achieve this objective for the manipulator is to offer a price to the short slightly below the marginal cost of delivery.

### 2.4.2 What happen if hedgers are not fragmented

In our model, the hedger is assumed to be an atomistic price taker, and she will be happy to accept any liquidation price which is less than the marginal cost of delivery. Under this circumstance, manipulation will succeed without involving much delivery. But what happens if there are a lot of shorts and they act to collude in the presence of manipulation. It is easy to imagine how this situation can arise in practice. The shorts at the last stage may collude each other to fight against the manipulator, or one relatively large short may buy out of other shorts' positions. In this case, the short will gain bargaining power with the manipulator to achieve a better price, instead of the price assigned by the manipulator. Manipulation is still possible as long as other conditions remain, but the profitability and the nature of equilibrium will change. It is predictable that the actual probability of manipulation will be less than what our model implies. However, the actual outcomes are indeterminate, which involves a game with bilateral bargaining. We do not intend to pursue this problem into details here.

### 2.4.3 How the large trader behaves in multi-period models

Another interesting consideration is to see what happens if we extend our model from the single period to two- or multi-period. We briefly consider a two-period model here. Assume futures trading takes place on two dates, date 1 and date 2 respectively. On date 1 and 2, the large trader and the hedger trade futures contracts that expire on date 3. The cash price on date 3 is determined by the deliverable stocks, and demand and supply disturbance  $\varepsilon$ . Futures prices on date 1 and date 2 which are quoted by market makers after observing date 1 and date 2's order flow, are  $f_1$  and  $f_2$ . The hedger expects to have exogenous risk exposure  $Z_1 + Z_2$  on date 3, and hedge in futures market to cover the exposure of  $Z_1$  outstanding on date 1 and  $Z_2$  on date 2 respectively.

Assume the classes of game players and the types of large trader are exactly the same as what we described in the previous game. The hedger has a prior assessment ( $q$ ) of the large trader's type before she makes decisions to hedge her risk exposure  $Z_1$  on date

1. Assume  $0 < q < q^*$ , trade precedes as discussed in previous game. Although both the hedger and market makers do not observe the large trader's type, after date 1' trading, the hedger can infer from the previous delivery prices, futures prices and her own first period's position about the large trader's type, and update her beliefs before she enters into the second period's trading. Assume  $\mu$  is the posterior probability of manipulation, then  $\mu = Pr[T_i = T_1 | f_1, H]$ . The hedger will trade on date 2 only if the large trader is not the type I with certainty.

It is interesting to note that, the large trader's optimal strategy will change enormously. Put in other words, the optimal strategy for the large trader may not be an equilibrium strategy in this two-period game. It is clear that the manipulator has incentives to convey the information that he is not the type I on date 1. Since if he chooses to manipulate at date 1, there may be less profitable opportunities at date 2. The indirect way of doing it may be to signal by choosing futures position being low even if he is the type I. The less profits from the date 1' trading may be offset by the second period's gains, so the total expected profits may be maximized. There are clearly many equilibria in this game. We are not going to delve into equilibrium analysis here (Chapter 3 mainly deals with a dynamic model, but the market structure is slightly different from what we are considering here). Manipulation can still occur in equilibrium. The conditions for the occurrence of manipulation are the similar as those in the previous game, but the large trader manipulates the other traders' beliefs so that he maximises his total expected profits. On the other hand, the losses to the hedger may be even larger. The effects of manipulation are clearer: the equilibrium futures price is kept higher than the competitive level for longer periods, and hedging activities are discouraged by the higher costs imposed by the manipulator.

## 2.5 Traders' Behaviour and Policy Implications

### 2.5.1 Traders' behaviour

Our futures manipulation model shows if a manipulation is not considered to be very likely by other traders, and the marginal cost of delivery is sufficiently high, manipulation can occur in equilibrium. The large trader makes positive expected profits by either manipulating or speculating. In the presence of manipulation, the large trader's profits come at the expense of the hedger and market makers; while there is no manipulation, his profits may come either from the hedger or from the market makers alone. At the same time, market makers can possibly benefit from making the market, which is also at the expense of the hedger, and the hedger can also possibly benefit from her short positions when there is no manipulation, which is at the expense of the market makers.

#### The behaviour of market makers

The market makers holding their prior beliefs regarding the large trader's type and observing the trading process quote futures price. They expect the cash price at contract expiration is either  $P(\cdot)$ , if the large trader is the type I; or  $p(\cdot)$ , if the large trader is the type II. Although they try to infer the large trader's type from order flow, they cannot identify whether a specific order is from the hedger or from the large trader or from noise traders, since the large trader is not so foolish that he trades in such a way that his type is revealed on date 1. The only way in which the market makers can do is to keep some optimal value  $\theta^*$  of net order flows in mind and price futures to a probability-weighted average level using their prior beliefs on the large trader's types and additional information from the net order flow. When there is no manipulation, the market makers either offer to the hedger (as in the case of proposition 1) at the price  $p(\cdot) + \Phi(Q_i^* - H^* + \varsigma)[P(\cdot) - p(\cdot)]$ . As time approaches date 2, they realise that there is no manipulation, hence the cash price will be at the competitive level, and they liquidate their net short positions to realise a profit; or they bid to the hedger and the large trader (as in the case of proposition

2) at that price. After they realise that there is no manipulation, they liquidate their net long positions to suffer a loss. When there is a manipulation, the market makers offer to the manipulator at the price  $p(.) + \Phi(Q_i^* - H^* + \varsigma)[P(.) - p(.)]$ , but the ultimate price will be the manipulated price (the marginal cost of delivery), then they liquidate their positions and suffer a loss. It is hard to gauge whether the market makers can break even, which depends on the frequency of manipulation and the size of net positions they take in each case. But as in the case of informed trading, it may be safe to conclude that manipulation discourages market making activities. The consequences would be that they adjust the bid-ask spreads to protect themselves (but we did not model bid-ask spread in our model, for details, see Glosten and Milgrom 1985).

### **The behaviour of the hedger**

The market makers lose to the large trader in the presence of manipulation, and they can either benefit from the hedger or lose to the hedger when there is no manipulation. But their losses can be protected by their advantageous position of the second-movers, since the presence of either large long net order flow or net short order flow will force them to change their price quotations. Obviously, the hedger is in general the loser. When she takes a short position at  $p(.) + \Phi(Q_i^* - H^* + \varsigma)[P(.) - p(.)]$ , if the large trader manipulates, the final price on date 2 rises to the marginal cost of delivery, then she suffers a loss. The size of the loss is approximately measured as  $-(1 - \Phi(Q_i^* - H^* + \varsigma))[P(.) - p(.)]H^*$ . If the large trader speculates, the final price is the competitive price, she makes a profit in futures trading, and the profit is measured as  $\Phi(Q_i^* - H^* + \varsigma)[P(.) - p(.)]H^*$ . When she takes a long position at  $p(.) + \Phi(Q_i^* - H^* + \varsigma)[P(.) - p(.)]$ , and if the large trader speculates, the final price falls to the competitive level, therefore she suffers a loss again. The loss is approximately measured as  $-q\Phi(Q_i^* - H^* + \varsigma)[P(.) - p(.)]H^*$ . Although the hedger can benefit from futures trading sometimes, she must share the limited profits from market makers with the large trader. Therefore, in general the profits cannot make up for the losses. The hedger cannot do better than that, because she is the least informed. The

only way in which she can protect herself is to hedge less the risk that would be fully hedged in a futures market without manipulation or stay out of futures market altogether. Hence manipulation discourages hedging activities.

From the equilibrium analysis above, it is clear that the equilibrium probability of manipulation is necessarily not greater than the prior beliefs in the market on the probability that the large trader belongs to the type I,  $q$ . More strictly, it is less than  $q^*$ , the critical value of the market beliefs on the probability of manipulation for a manipulation to occur in equilibrium. This may offer a partial explanation of the fact that actual manipulation is not so often in commodity futures markets, although conditions for the occurrence of manipulation are rather weak in our model.

### 2.5.2 Policy implications

Our model predicts that long manipulation typically increases the equilibrium futures price and discourages hedging, and more important, manipulation causes futures price to be a biased estimate of the future cash price from the point view of all market participants and observers except the market makers. The unbiasedness is not held for the large trader and the hedger because they are not able to observe the net order flow, although the large trader knows his own type and the hedger's objective function. This implies the proper functioning of futures markets is impaired. Therefore, traders and market observers who make their production, storage or investment decisions based on the futures price may be misled. There are other welfare costs of manipulation. Firstly, manipulation may create unnecessary costs of delivery. As showed in the model, for a manipulation to occur in equilibrium, it is necessary for the large trader to demand or threaten to demand an amount of delivery exceeding the normal level of deliverable stocks, which will result in unnecessary costs of delivery. These costs include transportation costs of shipping commodity from non-delivery markets to delivery point, grading costs of transforming non-deliverable commodity into contract specified warehouses, etc. Secondly, manipulation may distort spatial consumption patterns of the commodity. Ma-



manipulation increases the price of the commodity in the delivery market, which benefits the owners of the commodity and increases the costs of consumption of the commodity. It may also attract more than normal level of delivery to the delivery point and the price of the commodity will fall at the delivery market after delivery is made due to the burying the corpse effect. This will result in too much consumption in the delivery market and too little at non-delivery points, and the distortions of price relationships between the delivery market and non-delivery points. Thirdly, manipulation discourages hedging not only through the hedger's loss of money consistently, but also by the loss of utility through less hedging than in the competitive case, since the hedger anticipates the possibility of a higher cash price at delivery due to manipulation. These are the important social costs of manipulation, which provides the rationale for futures regulation. It is therefore beneficial for a response of public policies to lowering the actual probability of manipulation  $\Phi(\cdot)$ , and thereby lowering the market beliefs on the probability of manipulation, the  $q$ . Explicit considerations of futures regulation are left to Chapter 5, we briefly analyse to what extent futures manipulation as modeled in this Chapter can be deterred or eliminated by using some commonly proposed anti-manipulation rules which are either imposed by futures exchanges, regulatory authorities or self-regulatory organisations.

## **Delivery options**

Delivery options aims at increasing deliverable supply at the delivery market, which will reduce the profitability of manipulation by increasing the elasticity of the marginal cost of delivery. Adding delivery options clearly has beneficial effects on reducing the probability of manipulation.

One way to increase delivery supply is to add delivery points and to allow a futures contract to have multiple delivery grades. One main argument against this is that it may reduce hedging effectiveness of futures contracts (see, for example, Edwards and Edwards 1984; Fischel and Ross 1991, etc.). The reason is that adding delivery options

may decrease the relation between the futures price and the cash price in the specific deliverable commodity in the original futures contract. Another argument against this is that it may be a less effect means of transferring ownership of the physical commodity, since longs may receive delivery of the commodity at unsatisfactory location. Both arguments are not necessarily true after careful examinations. Firstly, although multiple delivery points and grades will certainly reduce the correlation between the futures price and the price of the specific deliverable commodity, and therefore the hedging effectiveness for hedging that commodity, in any actual futures market, it is seldom that a hedger's hedge is exactly matched with the specification of the contract, and most hedges are cross hedges where there is mismatch in the location or grade of the hedge and the location or grade deliverable against any futures contract. Secondly, a futures market is to provide a mechanism for price discovery and risk shifting, but not a merchandising tool for physical commodities (Bianco 1977, p.29).

However, in practice there is still a trade-off between adding delivery options to reduce the probability of manipulation and hedging effectiveness of some specific commodities. Too broader delivery options will danger a futures contract for hedging some specific risk and therefore the liquidity and the success of a contract. The optimal amount of delivery options may differ cross different commodities and extensive discussions are beyond the scope of this chapter.

In general, it may be beneficial to allow delivery of a futures contract at a variety of points or of variety of grades in order to reduce the frequency of manipulation. But this does not imply that delivery options can eliminate manipulation altogether, since it is too costly and indeed not feasible to construct a perfect elasticity of the commodity by simply adding delivery options, and too many delivery options may make a futures contract less useful in providing a mechanism for discovering the price and shifting the risk for some specific commodities.

## Cash settlement

Cash settlement has been proposed as a device to reduce or eliminate futures manipulation by using the physical delivery mechanism. A cash settlement futures contract establishes an obligation for the shorts to deliver cash to longs in an amount equal to a *settlement index* that reflects the cash market value of a particular commodity. It is true, if the *settlement index* is free of manipulative influences, futures manipulation would be eliminated entirely, and the long has no incentive to bid the futures price to reflect the marginal cost of delivery by establishing an extremely large position. But in practice, it is very difficult to construct the *settlement index* for commodities which is free of manipulation. The usual way to construct *settlement index* is to base it on cash market prices or on the transaction prices. If so, cash settlement does not affect manipulation very much. As we showed in our model, manipulation only occurs when the deliverable supply is “tight”, the cash prices or transaction prices which are the basis of the price index for cash settlement are very likely to be manipulatable. In this case, manipulation of futures market and manipulation of cash market would occur jointly. For example, suppose we use cash price as the cash settlement price in our model, and if the hedger is sure that the large trader is the type I after date 1’s trading, she is aware that both the cash and futures prices prevailing on date 2 would be pushed up to  $P(\cdot)$ , which will be the settlement price on date 2, and she will be willing to pay up to  $P(\cdot)$  to cancel her contractual obligations. Therefore, the cash settlement does not affect manipulation except that the large trader may bid the cash price to the level of the marginal cost of delivery by buying the deliverable stocks and sell them at the post-delivery price.

However, if we can construct a cash settlement index which is based on the average price of a group of related commodities in local markets, a group of the same commodities in different locations, manipulation would be better deterred or eliminated. But this construction may be subject to ignorance of current market conditions. More important, it creates difficulties for hedgers to hedge specific risks, which is critical to the success of a commodity futures contract.

## Position limits and position reporting

Position limits, if well devised, have beneficial effects on the manipulation prevention. Position limits are usually imposed on the long positions, which is premised on the historical experience that short manipulation is rare.

In our model, we show long manipulation would occur if a manipulation is not considered to be very likely by other traders, the additional deliverable stocks are not inexpensively available and the large trader's futures position exceeds the deliverable stocks at the delivery point at contract maturity. Clearly, if we set a position limit which is less than the deliverable stocks at the contract maturity, pure squeezes will be eliminated, but which is not necessarily true for corners. A corner's action on cash markets can reduce the stocks available for shorts to make delivery to a certain amount by controlling cash stocks at hand, so that his limited futures position can still possibly exceed the deliverable stocks available for the shorts to make delivery. More important, it is beneficial to be aware that position limits do not affect the occurrence of corners if we only impose position limits on the futures positions, except that they do discourage corners by reducing their expected profits. The potential beneficial way to impose position limits is to extend the limits from futures positions only to cash positions, positions on OTC markets, and options positions. Once this is done, manipulation would be well prevented in our model.

However, position limits are less effective in practice. Three main reasons lie in: first, it is possible for several large traders to act co-operatively to manipulate a market; second, position limits should be set according to the deliverable stocks of a specific market, but deliverable stocks are changeable from time to time, and it is therefore naturally difficult to work out criteria for these limits; and finally, in order to achieve the preventive effects of position limits on manipulation, it is essential to extend the limits from futures to other markets. This provokes potential conflicts among regulatory authorities on different markets and also ultimately imposes huge costs on market users.

The Large Trader Reporting System by the CFTC has been argued to be an effective

way to prevent manipulation in the United States. The US large trader reporting system requires that reports be filed with the CFTC for futures contracts and options on futures by four primary sources: positions holding bona fide hedge positions; contracts market; foreign and domestic traders and futures commission merchants (FCMs) and foreign brokers. Any trader, either foreign or domestic, who holds controls, or has a financial interest in an open futures position which equals or exceeds the fixed reporting level for that particular commodity (reporting position) must file until his position declines below the reporting level. A reportable trader must be required to file two types of reports. The first, the CFTC form 40 (statement of reporting trader) which must be filed no later than 10 business days after the trader assumes a reportable futures position, identifies the trader and discloses the identity of persons who have a significant financial interest in, or control the trading of, the reportable account. The second type, the CFTC series '03 reports', must be filed for the time period specified in a special call, provides the CFTC with the raw position data of the reportable trader. The information is subsequently released by the CFTC in aggregated form in the weekly Commitments of Traders in Futures (CTF) reports.

A large trader reporting system aims at reducing manipulation probability through increasing market transparency.. It is very effective tool in manipulation deterrence and manipulation prevention. Firstly, a large trader reporting system has effects on manipulation deterrence. With the large trader reporting system, it is true that the large trader must act less aggressively to make a manipulation less likely to occur. Since his position must be filed with the CFTC, if he does optimally, he is likely to be prosecuted successfully *ex post* by the CFTC. Secondly, the large trader reporting system has preventative effects on manipulation. The CFTC publishes CTF reports weekly, and from this information other traders become more aware of an increase in the concentration in long positions which might result in a manipulation, they can manage their positions accordingly, thus prohibiting manipulation to a certain degree.

We must admit the limitations of the effects of the large trader reporting system

on manipulation. First, we lack an obvious criteria for the reportable position, if the reportable position is defined too large, the system does not work, or does not work well; but if too small, it may impair the trading incentives for some large commercial traders. Second, it does not rule out the possibility for several large traders to manipulate a market cooperatively. Third, the current reporting is confined to on-exchange positions. Finally, as analysed above, the system's effects on the prevention of manipulation work partially through its deterrent effects by *ex post* prosecutions, which is conditional on the supposition that manipulation is made a felony legally, but futures regulation has not been so in most countries except the USA.

## 2.6 Conclusions

We examined a simple model based on some informational and game-theoretic assumptions. We have shown that manipulation, either as a “squeeze” or as a “corner”, may occur in equilibrium under certain conditions. Manipulation has adverse effects on the functioning of futures markets. Manipulation distorts the relationship between futures price and the expected cash price, and futures price is not an unbiased estimate of the future cash price anymore from the point view of all market participants or observers except the market makers. Long manipulation typically increases the equilibrium futures price, discourages hedging activities, and results in other welfare costs to society..

The risk averse hedger who is the least informed, but is persuaded to use the advanced form of market organisation - futures markets to hedge her risk exposure is in general the loser; the market makers who are committed to make the market, although they can observe the trading process, are still uncertain about the large trader's type. They can lose to the informed trader. although sometimes they may gain from the hedger; the only winner is the large trader because of his privileged information.

One attractive feature of our model is that the informational assumptions are less restrictive and closer to the real world compared with the previous models. Another

feature is that we demonstrate the uniqueness of equilibrium, and all traders act and response optimally in equilibrium according to the information available to them at the time of contracting. Finally, we modelled the hedger's behaviour explicitly, and more important, in contrast to the Kyle's model, the hedger's losing position in the presence of manipulation is endogenous in our analysis.

Some commonly proposed measures to fight against manipulation are briefly analysed. Although some have beneficial effects on the prevention of manipulation, we have to be aware that factors to trigger the occurrence of manipulation are mainly from the features of futures markets and futures trading themselves. Therefore, we expect to face a trade-off between the elimination of manipulation and the elimination of futures trading altogether.

Possible extensions of this single-period model to a two- or multi-period model, or from a single large trader model to a simultaneous-move model with two or more large traders, or from a model with one atomistic hedger to a model with one or several powerful hedgers with bargaining power, under our informational structure, may reveal the traders' behaviour more explicitly, which is the direction of future research.

# Chapter 3

## A Dynamic Futures Manipulation Game with Incomplete Information

### 3.1 Introduction

As discussed in the previous chapter, in addition to delivery market characteristics and noise trading, asymmetric information problem exists in futures markets. These may also help to explain the vulnerability of a futures market to manipulation. When other traders are less aware of the presence of a manipulator, a manipulation may occur in equilibrium. Since under this circumstance, there is a significant probability that the manipulator acquires a huge futures position from other traders which exceeds the deliverable supply and thereby squeezes the shorts successfully. However, when this is considered to be likely by other traders, a manipulation is not profitable, as rational traders do not voluntarily stand on the other side of the market to get squeezed. In extreme cases, other traders will choose to stay out of futures trading altogether, and the market may break down. Therefore, a manipulator must attempt to hide behind other traders.

In a one-shot game with asymmetric information (Chapter 2) in which other traders cannot tell the large trader's type accurately, we show that the sufficient conditions for a manipulation to occur include: (i) the probability that the large trader is a manipulator



is below a certain critical level; (ii) delivery supply is inelastic to a certain degree. Manipulation can benefit the large trader in two ways. When a manipulation is considered to be very likely, he goes short and makes profits which are larger than those by assuming risk transferred by hedgers. When a manipulation is not highly expected by other traders, he may establish a large position and undertake a manipulation. The consequences are that futures price becomes a biased estimate of the future cash price from the point view of all traders except the market makers, and futures price is kept higher than the competitive level (in the presence of long manipulation). Therefore, futures manipulation reduces the accuracy of price discovery, discourages hedging activities, and results in other welfare costs.

In this chapter, we attempt to extend the above model of futures manipulation into a dynamic context using a slightly modified market structure. In the real world, we do not observe a high frequency of manipulation even in markets which meet the sufficient conditions above. Several reasons may be offered to explain this fact, apart from the differences in market characteristics. First, almost all futures markets are extensively regulated markets. Second, large traders, who use heavily futures markets, clearly do not wish to destroy the markets. Finally, other traders may detect a manipulator's presence from previous delivery prices and then shift their trading strategies accordingly, thus making manipulative strategies unsuccessful. Apart from futures regulation, we therefore expect that asymmetric information and the associated adverse selection problem may force a manipulator to behave like an ordinary speculator, such that his presence in the market is only detectable to a certain degree in a dynamic setting, and market manipulation only occurs occasionally. In a finitely repeated game, we conjecture that manipulation would not occur at all until the end of the game approaches if other traders can detect the large trader's type accurately *ex post* from available information. Otherwise, the market will break down until the manipulator leaves the market. However, full information revelation may be not realistic in any actual futures market, since it is usually impossible for traders to obtain some essential information even after delivery has

taken place or price is announced - for example, there may be very limited information on each trader's position, supply shocks, etc.

In sequential trading games, noise trading is commonly introduced to avoid fully revealing equilibria outcomes (see, for example, Kyle 1985; Back 1992; Foster and Viswanathan 1996; etc.), and this is assumed to be symmetric and uncorrelated with other variables. In these models, noise trading is effectively used as a disguise by the informed trader to minimise the price effects of his trading. The informed trader's profits are thus positively related to the variance of noise trading. This assumption of noise trading may be inappropriate in our manipulation game, since noise trading may bring additional dimension of risk to the large trader's decisions. We therefore, in addition to conventional noise trading, introduce a new variable, termed market uncertainty, which generalises some restrictions as implied by noise trading within informed trading models into this game, so that it affects traders' decision making in an important way.

As in informed trading models, we still assign noise trading the role of camouflage by the large trader such that it is impossible for the hedger to infer from her own futures position to the large trader's position, and hence discover the large trader's type accurately *ex post*, but it does not affect the large trader's decision-making very much (at least it is insufficient to destroy the large trader's strategy). This may be justified by assuming that the variance of noise trading is not large. The new variable - market uncertainty, is however important for the large trader's decision-making. It can be simply represented by assuming that there is a probability that the large trader may fail to achieve what he is intending, which may capture correlation effects among noise trading and other variables in the model, and may also incorporate other sources of exogenous uncertainty. This new variable may be justified by assuming that there is a probability that noise trading and supply shocks may simultaneously come into force, or his manipulative potential may be circumvented by the exchange or other regulatory authorities, which is not directly controlled by traders, but the probability of such occurrence can be estimated from history in a specific market. In a dynamic trading game, this uncertainty

is important, since it may change the large trader's behaviour enormously, and it may be more difficult for some traders to detect other traders' presence accurately. For example, here the hedger cannot tell whether a manipulator is in place perfectly even she observes a higher previous delivery price, and the manipulator himself is also uncertain whether a manipulation will be successful in the presence of this market uncertainty.

Although it is difficult to predict whether manipulation may occur less frequently with this exogenous uncertainty than that without it, the manipulator may behave less aggressively, the accuracy of 'price discovery' may be less disturbed and the hedger may be less seriously hurt in the case of manipulation in this model, since a manipulator must take this uncertainty into account when determining his trading strategy. The implication is that, increasing this uncertainty may help to reduce the adverse effects of manipulation, which justifies certain anti-manipulation rules currently imposed by some regulators or exchanges, such as trading for liquidation only, allowing shorts to default on contracts, trading halts, etc.

Based on these observations, we construct a two-period model with three classes of traders: one large trader with two types: type I and type II, where the type I is a speculator and the type II is a manipulator; one representative hedger and noise traders. The hedger who hedges her exogenous risk exposure in cash markets by using a futures market, is uncertain about the large trader's type, and therefore his payoff function. But she holds some beliefs on the large trader's type when making her hedging decisions. The large trader, who possesses market power, can manipulate other traders' beliefs on his type, and move the market to his advantage. He can do so by mimicing the type I trader to some extent so that the manipulation probability is kept sufficiently low at the initial period and then to manipulate the market in the last period. The hedger observing the previous contract delivery process updates her beliefs and makes the second period trading decision, but she cannot identify the large trader' type accurately because of noise trading and some degree of exogenous uncertainty. The consequence is that, there always exists some positive probability of manipulation in the market, and the futures

price is kept above the competitive level.

Our purpose here is to investigate how a large trader manipulates a futures market successfully even when the hedger trades strategically, and how other parameters affect the nature of equilibrium. This makes our model setting differ in many aspects from standard market microstructure literature where the focus is to analyse how a market maker learns from the order flow and how this, in turn, affects the movement of prices over time:

First, information-based trades arise from different sources. Market microstructure models (for example, Copeland and Galai 1983; Glosten and Milgrom 1985; Kyle 1985; etc.) assume that order flows may include information-based trades, and therefore market makers who observe the net order flow, can infer from the order flow about the traders' types and then quote bid-ask prices. While our model suggests that the delivery process (delivery price, the quantity of delivery taken, etc.) may contain information about the presence of a manipulator, and the hedger who observes the delivery process, can infer from it the possible existence of a manipulator.

Second, we implicitly allow traders to have price-elastic demand functions. In our model, both the hedger and the large trader's equilibrium strategies essentially depend on futures prices, although we do not explicitly assume that traders submit price-contingent orders, such as demand schedules as, for example, Kyle (1989). In standard market microstructure models, the informed is not allowed to condition his trades on prices.<sup>1</sup>

Finally, in our model, both the large trader and the hedger trade competitively to maximise their respective utilities and choose their trade sizes which allow the traders' behaviour to be analysed more explicitly. In standard market microstructure models, however, the uninformed (the market maker) is normally assumed to be not a utility maximiser and the informed trader's trading size is restricted in order to avoid instant-

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<sup>1</sup>See, for example, Copeland and Galai (1983), Glosten and Milgrom (1985), etc. In these models, informed traders will prefer to trade as much and as often as possible as long as prices are not at full information levels. To avoid this instantaneous revelation outcome, they assume that traders are chosen to trade probabilistically, and a trader allows to trade at most one unit of asset when it is his turn to trade.

neous information revelation outcome (see, for example, Glosten and Milgrom 1985).

The rest of this chapter is organised as follows. In section 3.2, we describe the basic structure of the market we are modelling. Section 3.3 provides traders' information sets, strategies and the equilibrium concept. In section 3.4, we analyse the properties of equilibria and derive the sufficient conditions for the existence as well as non-existence of manipulative strategies. Finally, brief concluding remarks complete this chapter.

## 3.2 Structure of the Model

### 3.2.1 The market and traders

We concentrate our attention on a commodity futures market with manipulation history. The market we are modelling involves no transaction costs. All orders are market orders. The market is cleared by setting total long orders equal total short orders. Futures positions are settled by delivery at the end of each period. At the beginning of each period, traders simultaneously submit orders according to information available to them.

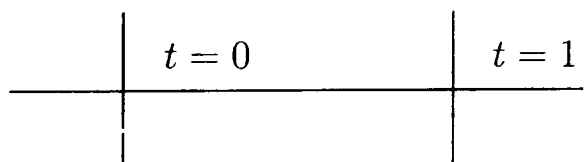
There are three classes of traders. One large trader with two types: the type I trader always speculates to maximise utilities by taking risk transferred from the hedger; the type II trader manipulates the market to maximise his utilities. Both are risk averse, but the type II is less risk averse. His less risk aversion and low costs of manipulation may justify his type as a manipulator, which may arise from his well-diversified portfolios, easier accessibility to external finance, scope of business involved, etc. In addition, the market contains one representative risk averse hedger; and continuum of noise traders who trade for exogenous reasons. This game is played by the large trader and the hedger strategically.

The large trader is an imperfect competitor, and he maximises his expected utility given his type, but takes into account the impacts of his trading strategy (futures position) on the equilibrium futures price. The hedger maximises her utility given the information available to her. Given the specific utility function form (for details, see Section 3.4.1),

each trader (except noise traders) is effectively seen to submit a linear demand schedule which is conditional on the futures price. The market is cleared by aggregating the amount of noise trading and the schedules submitted by the large trader and the hedger. In this aspect, the market clearing mechanism looks like a “Walrasian” auctioneer, who aggregates the total demands, calculates a market clearing price and allocates quantities to satisfy traders’ demands. Theoretically, there is a probability that a market clearing price does not exist when there is positive excess demand or negative excess demand at all prices. We therefore assume that the auctioneer can announce a positively infinite futures price when there is positive excess demand so that buyers will receive negatively infinite utility, or a negatively infinite futures price when there is negative excess demand so that sellers receive negatively infinite utility. Under these circumstances, infinite price will not occur in equilibrium.

### 3.2.2 Timing of the model

We consider a two-period model in which the size of the population of traders is constant. It also captures the features of an overlapping-generations model. The large trader lives in both periods. The two hedgers live in only one period:  $t = 0, t = 1$  respectively, but they have memory. Once the hedger settles her futures position at the end of period 0, another representative hedger with the same preference as the previous one comes into the market. All strategic traders maximise their utilities by choosing their optimal futures positions.



The timing and events proceed as follows:

At  $t = 0$

The large trader is born with one of the two types: the type I with probability of  $q_0$  and the type II with probability of  $1 - q_0$ . Given these prior beliefs, the hedger forms her expectations on the delivery price at the end of  $t = 0$  and decides her optimal hedge. The large trader chooses his strategy (the first period futures positions) to maximise his two-period utilities by taking into account the fact that his first period strategy affects the hedger's beliefs regarding his type. All positions are settled either by delivery or through offsetting by the end of the period.

At  $t = 1$

Given the delivery of the first period futures contract has been taken, the hedger by observing the delivery process updates her beliefs according to Bayes' rule. The hedger chooses her optimal strategy to maximise her utilities, while the large trader decides his futures positions which mature at the end of period 1 accordingly. Essentially, the large trader's second period strategy is determined by his first period actions. After the end of period 1, the large trader leaves the market.

### 3.3 Information and Strategies

#### 3.3.1 Information sets

##### Common knowledge

All traders have equal access to information about previous equilibrium futures prices, delivery prices and other relevant information during the delivery processes. When there is no market uncertainty, delivery prices for the two periods are determined by the demand and supply conditions of the underlying assets prevailing at that time. Without loss of generality, we assume that the delivery (cash) price is expected to be two-point distributed, which equals either  $P(\cdot)$  or  $p(\cdot)$ , and is the same for the two periods.  $(\cdot)$  denotes the content of supply shocks which are assumed to be normally distributed with mean 0 and variance  $\sigma_\varepsilon^2$ .

There is a prior probability  $q_0$  that the large trader belongs to the type I, which can be calculated from the previous delivery price. We assume that  $q_0$  is a sufficient statistic for the history up to the date  $t = 0$ . Mathematically  $q_0 = \text{prob}(T_i = T_1)$ .  $T_i$  denotes the large trader's type space  $T_i \in [T_1, T_2]$ , where  $T_1$  stands for the type I (the speculator) and  $T_2$  stands for the type II (the manipulator). This information is updatable according to Bayes' rule.

Noise traders trade aggregately a total position  $\eta$  in each period, which is normally distributed with mean 0 and variance  $\sigma_\eta^2$ . The representative hedger in each period hedges risk exposure  $Z_j$  outstanding at the end of each period respectively, where  $j = [0, 1]$ . For simplicity, we assume that  $Z_j = Z$ .

There is an exogenous uncertainty  $1 - \iota$ , where  $\iota > \frac{1}{2}$ , which is the probability that the large trader fails to achieve what he is intending, perhaps because of the correlation effects of noise trading with other variables in the model, or due to some other exogenous reasons.

### Asymmetric information

Nature draws the type of the large trader and discloses the information to the large trader only. Effectively, the large trader knows his own type, his payoff function and the hedger's payoff function; while the hedger is uncertain about the large trader type and therefore, his payoff function.

### 3.3.2 Information updating

The previous contract delivery process is observable by each trader. We assume that the delivery price contains sufficient information about the large trader's type. Without loss of generality, the delivery price observable by traders at the end of the first trading period is assumed to be either  $P^H$  or  $P^L$ , where  $P^L < P^H$ .  $P^H$  is the realised higher delivery price and  $P^L$  is the realised lower delivery price.

The higher price may contain two events: first, the large trader intends manipulation



and succeeds; second, the large trader intends speculation, but asymmetric noise trading or supply shocks or some other exogenous forces push the price to a high level. The hedger cannot tell the difference. Similarly, the lower price may also result from two events: first, the large trader intends speculation; and second, the large trader intends manipulation but fails. However, there is a positive relationship between the level of delivery price and the large trader's type.

Given the prior  $q_0$  that the large trader is the type I and the level of uncertainty  $(1-\iota)$ , after she observes the first period delivery process, the hedger's beliefs are updated using Bayes' rule. Thus if the type II trader is known to play the strategy of speculation with probability  $\theta$ , and intending manipulation with probability  $(1-\theta)$  at  $t=0$ , i.e., playing a mixed strategy intending speculation with probability  $\tilde{\theta}$ , then the hedger updates her beliefs:

$$q_1(P = P^L) = \frac{\iota q_0}{\iota q_0 + (1 - q_0)\tilde{\theta}} \quad (3.1)$$

if  $P = P^L$  is observed and

$$q_1(P = P^H) = \frac{(1 - \iota)q_0}{(1 - \iota)q_0 + (1 - q_0)(1 - \tilde{\theta})} \quad (3.2)$$

if  $P = P^H$  is observed, where  $\tilde{\theta} = \iota\theta + (1 - \theta)(1 - \iota)$ .

If  $\theta < 1$ , then  $\tilde{\theta} < \iota$  as long as  $(2\iota - 1) > 0$ , i.e.,  $1/2 < \iota < 1$ .

From equation (3.1) and (3.2), it is clear that conditional on  $P = P^L$ , if  $\tilde{\theta} < \iota$ , then  $q_1 > q_0$ , implying that market beliefs that the large trader is the type I improve if a lower first period delivery price is observed. Conditional on  $P = P^H$ , then  $q_1 < q_0$ , implying that market beliefs weaken if a higher first period delivery price is observed. The first period delivery price is also affected by the large trader's first period strategy. Given  $\tilde{\theta}$ , the hedger's expected probability of observing a lower delivery price at the end of  $t=0$  is  $\iota q_0 + (1 - q_0)\tilde{\theta}$  and the expected probability of observing a higher delivery price is  $(1 - \iota)q_0 + (1 - q_0)(1 - \tilde{\theta})$ . Consequently the hedger's expected future cash price at the

end of  $t = 0$  is:

$$E_0^h(\tilde{p}) = P(.) - [\tilde{\theta} + \iota q_0 - q_0 \tilde{\theta}][P(.) - p(.)]$$

where  $\frac{\partial E_0^h(\tilde{p})}{\partial \tilde{\theta}} = -(1 - q_0)[P(.) - p(.)] < 0$  and  $\frac{\partial E_0^h(\tilde{p})}{\partial q_0} = (\tilde{\theta} - \iota)(P(.) - p(.)) < 0$ .

As  $\iota \rightarrow 1$ ,  $E_0^h(\tilde{p}) \rightarrow P(.) - [q_0 + (1 - q_0)\tilde{\theta}][P(.) - p(.)]$ . The hedger's expected price depends on the prior probability and the large trader's first period strategy only. As  $\iota \rightarrow \frac{1}{2}$ ,  $E_0^h(\tilde{p}) \rightarrow \frac{1}{2}[P(.) + p(.)]$ , implying that, as the market tends to become extremely uncertain, the hedger's expectations do not depend on the large trader's actions.

### 3.3.3 Extensive form representation

The large trader types are distinguished by manipulation or speculation, which is given by nature and revealed to the large trader. This is a game of incomplete information about the large trader's cost functions and risk tolerance. We adopt the approach proposed by Harsanyi (1967), which involves replacing this incomplete information game by a game of complete but imperfect information. This allows us to treat the Nash equilibria of this second game as the equilibria of the original game. The imperfect information game involves another player, "Nature", which is indifferent over all possible outcomes. Nature moves first to select  $T_i$  according to the probability distribution:  $q_0 = \Pr(T_i = T_1) = 1 - \Pr(T_i = T_2)$ . The large trader is then informed about  $T_i$ , but the hedger is not.

The large trader's strategy in each period is either manipulation or speculation. Manipulation implies the large trader expects a high delivery price and chooses a large futures position which exceeds normal level of deliverable stocks. Speculation means that he has no intention to move prices and chooses a futures position according to the risk he is able to assume. Let  $s$  and  $m$  denote speculation and manipulation respectively. The large trader's strategy space is defined as  $S_j \in [s_j, m_j]$ , where  $S_j \in (-\infty, +\infty)$ ,  $j = [0, 1]$ ,  $j$  stands for the two periods specifically. A positive value of  $S_j$  represents going long in futures and a negative value represents going short in futures. The hedger's strategy is to hedge her risk exposure in cash markets using futures contracts. The strategy space

is defined as  $H_j = h_j$ , where  $H_j \in (-\infty, +\infty)$ . A positive value of  $H_j$  represents going short in futures and a negative value stands for going long in futures.

The real action in this game comes in the first period when the large trader chooses futures positions  $S$  taking the hedger's expected delivery price at the first period  $E_0^h(\tilde{p})$  as given, but taking into account the way in which the hedger forms her expectations in the second period  $E_1^h(\tilde{p})$  as a function of the type inferred from the events at the end of the first period.

The positions that the large trader obtained are unobservable. But the final delivery price is observable by all traders. After observing the delivery process in the first period, the hedger updates her information regarding the large trader's type using Bayes' rule. The information updating process is additionally blurred by the introduction of exogenous uncertainty. It can arise from the correlation effects between noise trading and supply shocks or other exogenous reasons.

We follow the notation of sequential equilibrium developed by Kreps and Wilson (1982a, 1982b). A sequential equilibrium comprises a strategy for each trader and for each period  $j$ , where  $j = [0, 1]$ ,  $q_j$  taking histories of moves up to period  $j$  into numbers in  $[0, 1]$  such that:

- In each period, the hedger's strategy is optimal, given her beliefs in that period and given the large trader's equilibrium strategy;
- In the two periods, the large trader's strategy is optimal, given his types and given the equilibrium strategy by the hedger in each period;
- Given the equilibrium strategies followed by the two types of the large trader, the hedger's posterior beliefs are derived from the prior beliefs and the observations of delivery process at the end of period 0.

## 3.4 The Existence of Manipulation Strategies

### 3.4.1 Payoff functions

All traders have mean-variance utility functions. Let  $E$  denote expectations;  $U$  denote utility;  $\Pi$  denote profits, and  $\rho, \kappa, \lambda$  denote constant absolute risk aversions for the speculator (type I), the manipulator (type II) and the hedger respectively, where  $\kappa < \rho < \lambda$ . Traders' expected payoffs can be written as follows:

1. Payoff functions for the large trader

If he is a speculator, his expected payoffs are:

$$E^s(U) = E^s[\sum U_j]$$

where  $j = 0, 1$ ,  $s$  denotes a speculator, and  $E^s(U_j) = E^s(\Pi_j) - 0.5\rho Var[\Pi_j^s]$ ,  $E^s(\Pi_j) = s_j * [E_j^s(\tilde{p}) - f_j]$ .

If he is the manipulator, his expected payoffs are:

$$E^m(U) = E^m(\sum U_j)$$

where  $m$  denotes the manipulator, and  $E^m(U_j) = E^m(\Pi_j) - 0.5\kappa Var(\Pi_j)$ ,  $E^m(\Pi_j) = m_j * [E_j^m(\tilde{p}) - f_j]$ .

2. Payoff function for the hedger

The hedger's expected payoffs are:

$$E^h(U_j) = E^h(\Pi_j) - 0.5\lambda Var(\Pi_j)$$

where  $\Pi_j^h = Z\tilde{p} + (f_j - \tilde{p})h_j$  and  $Z$  is the hedger's risk exposure outstanding at the end of each period.

### 3.4.2 Assumptions

In order to simplify the solution to this game, we additionally require the following assumptions.

- Assumption 1 The futures market is highly liquid and delivery market is imperfectly elastic.

By assumption 1, we can ignore the large trader's decisions related to the cash (delivery) market. Cash market conditions, such as supply elasticity of deliverable stocks, burying the corpse effects, etc., are actually critical to the success of a manipulation. For relevant analysis, see Pirrong (1995b) and Wang (1997). After this simplification, the large trader can always manipulate by taking sufficient positions which exceed deliverable stocks if a manipulation is not considered by the hedger to be very likely, i.e., the hedger will hedge actively.

- Assumption 2 Expected utility functions  $E(U)$  are strictly increasing, twice continuously differentiable and concave.

### 3.4.3 Sufficient conditions for the existence of manipulation strategies

In this section, we turn to examine equilibrium properties of this game. As the first step in characterizing the equilibrium, we claim that the prior beliefs are essential to the existence of manipulation strategies. If the prior probability that the large trader belongs to the type I is lower than a critical level, speculation strategy strictly dominates manipulation strategy in equilibrium.

**Proposition 1** *Given other exogenous parameters, there exists a prior probability  $q_0^*$  such that for any other values of  $q_0 \leq q_0^*$ , speculation strategy dominates manipulation*

strategy at  $t = 0$ . Where  $q_0^*$  is given by the following equation:

$$q_0^* = \frac{1}{\iota - \tilde{\theta}} \left( 1 - \tilde{\theta} - \iota + \frac{(\lambda + \kappa)\sigma_\epsilon^2 x - (\lambda Z + \kappa\eta)\sigma_\epsilon^2}{\lambda(P(\cdot) - p(\cdot))} \right) \quad (3.3)$$

and  $x$  is the normal level of deliverable stocks at the end of period 0.

**Proof.** see Appendix.

From equation (3.3), given other parameters, it is easy to see that the critical value of the initial beliefs increases with the normal level of deliverable stocks and the variance of supply shocks, but decreases with the hedger's total risk exposure and the price difference between the manipulated price and the competitive price.

The intuition behind proposition 1 is very simple. When the prior is low, the hedger expects a high price at delivery, and will hedge less. If the prior is lower than a level such that the hedger's total hedge is less than the normal level of deliverable stocks at delivery, the large trader will by no means acquire a position which is sufficiently large to manipulate profitably. Since the large trader also knows that, he will definitely not submit a large market order to the market.

Equations (A.3.1) and (A.3.2) also present two important results we wish to claim in this model, i.e., long manipulation typically increases the equilibrium price and manipulation discourages hedging activities (recall that  $q_0$  is the probability that the large trader is the speculator here). From equation (A.3.1), it is easy to find that the higher the probability of manipulation, the higher is the futures price, i.e.,  $\frac{\partial f_0}{\partial q_0} = -\frac{\kappa(\iota - \tilde{\theta})(P(\cdot) - p(\cdot))}{\lambda + \kappa} < 0$ ; while from equation (A.3.2), we have the higher the probability of manipulation, the less should the hedger hedge optimally, i.e.,  $\frac{\partial h_0}{\partial q_0} = \frac{\lambda(\iota - \tilde{\theta})(P(\cdot) - p(\cdot))}{\lambda + \kappa} > 0$ .

The next propositions are related to the nature of equilibria when the initial market beliefs exceed this critical level.

**Proposition 2** *For some values of  $q > q^*$ , mixed strategies of manipulation exist if and only if the relationships among the prior beliefs, the certainty level of the market and the randomisation level of the large trader's first period strategy satisfy the following*

condition:

$$\tilde{\theta} = \iota - \frac{1}{1 - q_0} \left( -\frac{N}{M} + \frac{(2\iota - 1)}{a - b} (b - \sqrt{ab - b^2}) \right)$$

where  $a = \frac{\rho}{(\lambda + \rho)^2}$ ,  $b = \frac{\kappa}{(\lambda + \kappa)^2}$ ,  $M = P(.) - p(.)$ , and  $N = (Z_0 - \eta)\lambda\sigma_\epsilon^2$ .

**Proof.** see Appendix.

From Proposition 2, given other exogenous values, the level of randomisation is inversely related to the initial prior, or equivalently, the probability of manipulation increases with the values of the prior beliefs that the large trader is the type I. But the relationship between the probability of manipulation and the prior beliefs is less straightforward, we shall analyse this graphically using an example.

**Example 1** Assume that  $a = 0.32, b = 0.20, N = 8, M = 25$  and  $\iota = 0.95$ . Given these exogenous values of the model, the relationships between the prior probability and the level of randomisation ( $\tilde{\theta}$ ) is shown in Figure 3-1. From Figure 3-1, the level of randomisation is inversely related to the prior beliefs. Put in other words, the probability of manipulation increases with the initial beliefs. Moreover, this inverse relationship is not linear. The probability of manipulation increases more than proportionately with the prior beliefs when the initial beliefs reach a certain level, which is the critical value of  $q$  as derived in proposition 1.

**Corollary 1** *There exists a minimum value of  $q_0$ ,  $q'_0$ , where  $q'_0 > q^*$ , such that (pure) manipulation strategy dominates (pure) speculation strategy, where  $q'_0$  may be expressed*

$$q'_0 = \frac{N}{(2\iota - 1)M} \left( \sqrt{\frac{a}{b}} - 1 \right)$$

**Proof.** We wish to demonstrate that  $E^m(U_0, E_0^h(\tilde{p})) \geq E^s(U_0, E_0^h(\tilde{p}))$  for given values of other parameters.

If the large trader is known to play pure strategy of speculation, the hedger's expected delivery price is  $(1 - \iota)P(.) + \iota p(.)$ . The large trader's expected payoffs and the hedger's

expected payoffs are given as follows:

$$E_0^s(U_0, E_0^h(\tilde{p})) = [\iota p(.) + (1 - \iota)P(.) - f_0]s_0 - 0.5\rho Var\{[\iota p(.) + (1 - \iota)P(.) - f_0]s_0\} \quad (3.4)$$

$$E_0^h(U_0) = ZE_0^h(\tilde{p}) + (f_0 - E_0^h(\tilde{p}))h_0 - 0.5\lambda Var[ZE_0^h(\tilde{p}) + (f_0 - E_0^h(\tilde{p}))h_0] \quad (3.5)$$

Maximisation of equation (3.4) and (3.5) subject to the market clearing condition yields:

the optimal position for the large trader:

$$s_0 = \frac{\iota p(.) + (1 - \iota)P(.) - f_0}{\rho\sigma_\epsilon^2}$$

the optimal position for the hedger:

$$h_0 = Z + \frac{f_0 - [(1 - \iota)P(.) + \iota p(.)]}{\lambda\sigma_\epsilon^2}$$

and the equilibrium futures price for the period 0 is:

$$f_0 = \iota p(.) + (1 - \iota)P(.) - \frac{(Z - \eta)\lambda\rho\sigma_\epsilon^2}{\lambda + \rho}$$

The large trader's expected payoffs if he plays speculation are therefore,

$$E_0^s(U_0, E_0^h(\tilde{p})) = \frac{\rho((Z - \eta)\lambda\sigma_\epsilon^2)^2}{2(\lambda + \rho)^2\sigma_\epsilon^2} \quad (3.6)$$

If the large trader plays (pure) manipulation strategy, the hedger's expected price will be  $P(.) - ((2\iota - 1)q_0 + 1 - \iota)(P(.) - p(.))$ . Following the same procedure as above, we get the large trader's expected payoffs if he plays manipulation as:

$$E_0^m(U_0, E_0^h(\tilde{p})) = \frac{\kappa((2\iota - 1)q_0(P(.) - p(.)) + (Z - \eta)\lambda\sigma_\epsilon^2)^2}{2(\lambda + \kappa)^2\sigma_\epsilon^2} \quad (3.7)$$

From equation (3.6) and (3.7), for  $E^m(U_0, E_0^h(\tilde{p})) \geq E^s(U_0, E_0^h(\tilde{p}))$ , we require that



$q_0 \geq q_0'$ , where  $q_0'$  is given by

$$q_0' = \frac{N}{(2\iota - 1)M} \left( \sqrt{\frac{a}{b}} - 1 \right) \quad (3.8)$$

■

Equation (3.8) states that, the minimum requirement of the initial prior is positively related to the hedger's risk aversion and the variance of supply shocks, and is inverse to the market certainty level and the differences between manipulated price and the competitive price. The last component in equation (3.8) implies that the more inelastic the deliverable supply, the higher is the level of the initial prior required in order for the large trader to manipulate. This may be due to the implementation of a more cautious hedging strategy by the hedger if she expects that it is costly to bring additional supply to the delivery market.

Proposition 2 and Corollary 1 show that when the initial market beliefs are sufficiently high, the large trader, if he is the type II, will choose to manipulate. This result is not surprising. The large trader has private information on his own type when he chooses his strategy, while the hedger only expects a probability-weighted delivery price. When the prior probability that the large trader is the type I is high, the hedger will have sufficient incentives to hedge. This makes the market manipulatable, and the large trader will manipulate with probability 1. This result is consistent with the finding in Wang (1997) where the assumptions and market structures were slightly different.

In the next part of this section we wish to show how, in a dynamic context, the type II trader will behave. In order for the manipulator to behave rationally, we assume that manipulation strategy dominates speculation whenever a market is manipulatable. Essentially, we require that  $q_0$  satisfies the condition specified in equation (3.8) given other model parameters. In a two-period game, he is expected to choose to randomise the strategy of speculation to some extent and manipulate the market at the last stage such that his total payoffs are maximised. The idea is simple. If the large trader chooses

pure strategy of manipulation at the beginning, his type may be identified with higher probability, and he may have to forsake future profitable opportunities. In an extreme case, the market maybe break down until he leaves the market.

The fundamental problem is to find the large trader's optimal strategies such that his total utility is maximised and leaves the hedger with sufficient incentives to hedge.

We start from the second period. At  $t = 1$ , the type II trader (manipulator) always intends to manipulate, since the manipulation strategy always dominates the speculation strategy; while the type I trader always intends to speculate.

The probability of observing an actual higher price is  $q_1(1 - \iota) + (1 - q_1)\iota$ , and the probability of observing an actual lower price is  $q_1\iota + (1 - q_1)(1 - \iota)$ . The hedger's expected delivery price at the end of  $t = 1$  is therefore:

$$\begin{aligned} E_1^h(\tilde{p}) &= [q_1(1 - \iota) + (1 - q_1)\iota]P(.) + [q_1\iota + (1 - q_1)(1 - \iota)]p(.) \\ &= (q_1 + \iota - 2q_1\iota)[P(.) - p(.)] + p(.) \end{aligned} \quad (3.9)$$

where  $\frac{\partial E_1^h(\tilde{p})}{\partial q_1} = (1 - 2\iota)[P(.) - p(.)] < 0$  for  $\frac{1}{2} < \iota < 1$ .

The type II trader's problem is to maximise his expected utility by choosing a large futures position taking the hedger's expectations fixed, i.e.,

$$\begin{aligned} \max E^m(U_1) &= \max\{[\iota P(.) + (1 - \iota)p(.) - f_1]m_1 \\ &\quad - 0.5\kappa Var[[\iota P(.) + (1 - \iota)p(.) - f_1]m_1]\} \end{aligned} \quad (3.10)$$

subject to:

the hedger's participation constrain

$$\begin{aligned} &ZE_1^h(\tilde{p}) + (f_1 - E_1^h(\tilde{p}))h_1 - 0.5\lambda Var[ZE_1^h(\tilde{p}) + (f_1 - E_1^h(\tilde{p}))h_1] \\ \geq &ZE_1^h(\tilde{p}) + (f_1 - E_1^h(\tilde{p}))h_1' - 0.5\lambda Var[ZE_1^h(\tilde{p}) + (f_1 - E_1^h(\tilde{p}))h_1'] \end{aligned} \quad (3.11)$$

and the market clearing condition at  $t=1$

$$m_1 - h_1 + \eta = 0 \quad (3.12)$$

Maximisation of equations (3.10) and (3.11) subject to the market clearing condition at  $t = 1$  yields:

the large trader's optimal position:

$$m_1 = \frac{\iota P(.) + (1 - \iota)p(.) - f_1}{\kappa \sigma_\epsilon^2}$$

the hedger's optimal position:

$$h_1 = Z + \frac{f_1 - [(q_1 + \iota - 2q_1\iota)[P(.) - p(.)] + p(.)]}{\lambda \sigma_\epsilon^2}$$

where  $\frac{\partial h_1}{\partial q_1} = -(1 - 2\iota)[P(.) - p(.)] > 0$ , for  $1/2 < \iota < 1$ .

The equilibrium futures price at  $t = 1$  is therefore:

$$f_1 = \frac{\lambda[\iota P(.) + (1 - \iota)p(.)] + \kappa[(q_1(1 - 2\iota) + \iota)(P(.) - p(.)) + p(.)]}{\lambda + \kappa} - \frac{(Z - \eta)\kappa\lambda\sigma_\epsilon^2}{\lambda + \kappa} \quad (3.13)$$

where  $\frac{\partial f_1}{\partial q_1} = \frac{\kappa(1-2\iota)}{\lambda+\kappa}[P(.) - p(.)] < 0$

Substituting the futures price and the large trader's optimal position back to equation (3.10), we get the large trader's expected utility at  $t = 1$ :

$$E^m(U_1) = \frac{\kappa}{2(\lambda + \kappa)^2 \sigma_\epsilon^2} [-(1 - 2\iota)q_1(P(.) - p(.)) + (Z - \eta)\lambda\sigma_\epsilon^2]^2 \quad (3.14)$$

From equation (3.14), the expected utility from manipulation when a lower price is observed at  $t = 1$  is clearly larger than that when a higher price is observed, i.e.,  $E^m(U_1 | P = P^L) > E^m(U_1 | P = P^H)$ . The large trader will face a trade-off. If he chooses to manipulate at  $t = 0$ , there will be a higher posterior probability that the large trader is the type II, and his expected utility from manipulation at  $t = 1$  will be lower even if

the market is still manipulatable. We expect that the large trader will play a random strategy so that his total utilities are maximised.

Assume that the type II trader intends to speculate with probability  $\tilde{\theta}$  at  $t = 0$ . his total payoffs can be written as:

$$\begin{aligned} E(U) = & \tilde{\theta}\{E_0^s(U_0, E_0^h(\tilde{p})) + E_1^m(U_1 | P = P^L)\} \\ & + (1 - \tilde{\theta})\{E_0^m(U_0, E_0^h(\tilde{p})) + E_1^m(U_1 | P = P^H)\} \end{aligned} \quad (3.15)$$

where  $E_0^s(U_0, E_0^h(\tilde{p})) = [\iota p(.) + (1 - \iota)P(.) - f_0]s_0 - 0.5\rho Var\{[\iota p(.) + (1 - \iota)P(.) - f_0]s_0\}$ , and

$$E_0^m(U_0, E_0^h(\tilde{p})) = [\iota P(.) + (1 - \iota)p(.) - f_0']m_0 - 0.5\kappa Var\{[\iota P(.) + (1 - \iota)p(.) - f_0']m_0\}$$

If the prior beliefs at both periods are sufficiently high, i.e.,  $q_j > q^*$ , the solution to this game amounts for the type II trader to choose an optimal level ( $\tilde{\theta}^*$ ) of randomisation to maximise equation (3.15) subject to the hedger's participation constraints and market clearing conditions in both periods, these are:

the hedger's participation constraints:

$$E_0^h(U_0, h_0) \geq E_0^h(U_0, h_0') \quad (3.16)$$

$$E_1^h(U_1, h_1) \geq E_1^h(U_1, h_1') \quad (3.17)$$

the market clearing conditions:

$$S_0 - h_0 + \eta = 0 \quad (3.18)$$

$$S_1 - h_1 + \eta = 0 \quad (3.19)$$

The type II trader chooses  $\tilde{\theta}$  in the first period to maximise two-period payoffs, taking as fixed the hedgers' expectation of future delivery price, such the large trader's strategies  $(\tilde{\theta}, E_1^h(\tilde{p}))$  form a Nash equilibrium pair. The equilibrium values of  $\tilde{\theta}$  satisfy:

i)  $\tilde{\theta} = \iota$  or  $\theta = 1$  if and only if

$$E_0^s(U_0, E_0^h(\tilde{p})) + E_1^m(U_1 | P = P^L) > E_0^m(U_0, E_0^h(\tilde{p})) + E_1^m(U_1 | P = P^H)$$

ii) for some values of  $\tilde{\theta}$ ,  $\tilde{\theta} \in (1 - \iota, \iota)$  if and only if

$$E_0^s(U_0, E_0^h(\tilde{p})) + E_1^m(U_1 | P = P^L) = E_0^m(U_0, E_0^h(\tilde{p})) + E_1^m(U_1 | P = P^H)$$

iii)  $\tilde{\theta} = (1 - \iota)$  or  $\theta = 0$  if and only if

$$E_0^s(U_0, E_0^h(\tilde{p})) + E_1^m(U_1 | P = P^L) < E_0^m(U_0, E_0^h(\tilde{p})) + E_1^m(U_1 | P = P^H)$$

We turn to examine the large trader's strategy. As the first step, we claim that perfect pooling strategy for the large trader is not an equilibrium strategy. This rules out the possibility of pooling equilibrium in this model.

**Proposition 3** *There is never an equilibrium with  $\tilde{\theta} = \iota$ .*

**Proof.** This proof is by contradiction. Suppose that the large trader mimics the speculator perfectly at  $t = 0$ . In this case, the posterior probability equals to the prior regardless of the realization of the delivery price at the end of  $t = 0$ , and therefore, the type II trader's expected utilities are as the same when a high delivery price is observed as when a low price is observed, i.e.,  $E_1^m(U_1 | P = P^L) = E_1^m(U_1 | P = P^H)$ . For the pooling equilibrium condition to be satisfied (from the condition (i) above), we require that  $E_0^s(U_0, E_0^h(\tilde{p})) > E_0^m(U_0, E_0^h(\tilde{p}))$ , i.e., speculation strategy dominates manipulation strategy. It contradicts to the result of Corollary 1 that, at the first period the prior probability is sufficiently high, manipulation dominates speculation. Therefore, there is no equilibrium strategy with  $\tilde{\theta} = \iota$ . ■

The intuition behind proposition 3 is clear. Since other traders cannot infer the large trader's action in the first period directly even *ex post*, perfect pooling is not beneficial to the large trader at all, and he clearly will not choose this strategy. The large trader

may therefore have an incentive to mimic the type I trader to a certain degree in the first period, and manipulate at the last stage.

**Proposition 4** *There are mixed strategy equilibria if and only if the level of randomisation ( $\tilde{\theta}^*$ ) satisfies the following relationships:*

$$\tilde{\theta} = \iota + \frac{V^*}{1 - q_0}$$

where  $V^* \in (-\iota, 0)$ , and  $V^*$  is a root of the following equation:

$$\begin{aligned} 0 = & (c - 1)M^2V^2 + 2((c - 1)MN - (2\iota - 1)M^2)V + (c - 1)N^2 \\ & - (2\iota - 1)^2M^2 - 2(2\iota - 1)MN + (2\iota - 1)^2q_0M^2\left[\frac{(2\iota - 1)V^2 - 2\iota(1 - \iota)V}{(V + \iota)^2(1 - (V + \iota))^2}\right] \\ & - 2(2\iota - 1)q_0MN\left[\frac{V}{(V + \iota)(1 - (V + \iota))}\right] \end{aligned} \quad (3.20)$$

where  $c = \frac{a}{b} > 1$ .

**Proof.** From equations (3.10), (3.13) and (3.14), we have the expected utilities for the large trader at  $t = 1$ :

if a lower first period delivery price is observed,

$$E^m(U_1 | P = P^L) = \frac{\kappa}{2(\lambda + \kappa)^2\sigma_\epsilon^2} \left[ \frac{(2\iota - 1)\iota q_0}{\iota q_0 + (1 - q_0)\tilde{\theta}} (P(.) - p(.)) + (Z - \eta)\lambda\sigma_\epsilon^2 \right]^2$$

and if a higher delivery price is observed,

$$E^m(U_1 | P = P^H) = \frac{\kappa}{2(\lambda + \kappa)^2\sigma_\epsilon^2} \left[ \frac{(2\iota - 1)(1 - \iota)q_0}{(1 - \iota)q_0 + (1 - q_0)(1 - \tilde{\theta})} (P(.) - p(.)) + (Z - \eta)\lambda\sigma_\epsilon^2 \right]^2$$

We wish to find the optimal values of  $\tilde{\theta}$  such that the large trader is indifferent between the first period speculation and the second period manipulation, and the first period manipulation and the second period manipulation, i.e.,

$$E_0^s(U_0, E_0^h(\tilde{p})) + E_1^m(U_1 | P = P^L) = E_0^m(U_0, E_0^h(\tilde{p})) + E_1^m(U_1 | P = P^H)$$

Substituting the respective utilities into the above equation, we have:

$$a(VM+N)^2 + b\left(\frac{\iota(2\iota-1)q_0}{V+\iota}M+N\right)^2 - b((2\iota-1+V)M+N)^2 - b\left(\frac{(1-\iota)(2\iota-1)q_0}{1-(V+\iota)}M+N\right)^2 = 0 \quad (3.21)$$

Writing  $c = \frac{a}{b}$  and rearranging equation (3.21), we have

$$\begin{aligned} 0 = & (c-1)M^2V^2 + 2((c-1)MN - (2\iota-1)M^2)V + (c-1)N^2 \\ & - (2\iota-1)^2M^2 - 2(2\iota-1)MN + (2\iota-1)^2q_0M^2\left[\frac{(2\iota-1)V^2 - 2\iota(1-\iota)V}{(V+\iota)^2(1-(V+\iota))^2}\right] \\ & - 2(2\iota-1)q_0MN\left[\frac{V}{(V+\iota)(1-(V+\iota))}\right] \end{aligned}$$

Solving the equation, we can find a sensible root of  $V$ , the  $V^*$ , and the optimal level of randomisation  $\tilde{\theta} = \iota + \frac{V^*}{1-q_0}$ . ■

This result is, however, less intuitive. We provide an example to show how the mixed manipulation strategy depends on the level of certainty of the market and the prior beliefs over the large trader's type.

**Example 2** Let the value of equation (3.21) be  $\Omega$ . The value of the first item and the third item is expected to be negative (by proposition 2), while the value of the second and the last one is positive. We can evaluate the relationships among the prior beliefs that the large trader is the type I ( $q_0$ ), mixed manipulation strategy ( $1 - \tilde{\theta}$ ), and market uncertainty level ( $\iota$ ) numerically. We try to find the mixed strategy equilibrium point first, given  $q_0, \tilde{\theta}$  and other exogenous variables. Suppose  $\iota = 0.95$ ,  $q = 0.94$ ,  $a = 0.32$ ,  $b = 0.20$ ,  $M = 25$ ,  $N = 8$ . If  $\tilde{\theta} = 0.85$ , then  $\Omega = -9.6$ ; and if  $\tilde{\theta} = 0.82$ , then  $\Omega = 5.4$ . It is feasible to find a value of  $\tilde{\theta} \in (0.82, 0.85)$  such that  $\Omega = 0$ . The interpretation is that, given the initial beliefs and certainty level of the market, we find the optimal mixed strategy ( $\tilde{\theta}$ ) equilibrium point which belongs to the range between 0.82 and 0.85, i.e., it is optimal for the large trader to play manipulation with a probability which is between 0.15 and 0.18. From this example, we then find that, given the certainty level of the market, the probability of intending manipulation increases with the initial prior;

and given the initial prior, the probability of intending manipulation increases with the certainty level of the market. For example, if  $\tilde{\theta} = 0.85$ ,  $\iota = 0.95$ , then  $\Omega = -9.6$ ; while if  $\tilde{\theta} = 0.85$ ,  $\iota = 0.98$ , then  $\Omega = 82.7$ . However, we cannot claim in general that the uncertainty level of a market reduces the probability of manipulation, since the value of the prior probability is also an important factor in determining this relationship. For a very high level of prior, the reduction effects may not present, which is clear from next proposition.

Proposition 4 shows the existence of a mixed strategy equilibrium, but multiplicity of equilibrium is possible, since it appears that there is no monotonic relationship between the probability of manipulation and market uncertainty level, which depends on the level of prior beliefs on the large trader's type. It is conceivable that there may be a range of  $q_0$  over which  $\tilde{\theta}$  is falling in  $\iota$ , and there may also be a range over which  $\tilde{\theta}$  is rising in  $\iota$  (reduction effects). More explicit equilibrium analysis and comparative statics analysis are a subject of further research.

**Proposition 5** *A (pure) strategy of manipulation in the first period is only optimal when the prior probability and the uncertainty level are relatively high, i.e., given a high value of  $q_0$ , for  $\iota < \iota^*$ , intending manipulation is an optimal strategy for the large trader. Where  $\iota^*$  satisfies the following equation:*

$$\begin{aligned}
0 = & a(1 - 2\iota)^2 M^2 [a(1 - 2q_0) + (a - b)q_0^2] - 2(2\iota - 1)MN[a(1 - q_0) + bq_0] \\
& + (a - b)N^2 + bM^2 \left[ \left( \frac{\iota(2\iota - 1)}{1 - \iota - q_0 + 2\iota q_0} \right)^2 - \left( \frac{(1 - \iota)(2\iota - 1)}{\iota + q_0 - 2\iota q_0} \right)^2 \right] \\
& + 2bMN \left[ \frac{\iota(2\iota - 1)}{1 - \iota - q_0 + 2\iota q_0} - \frac{(1 - \iota)(2\iota - 1)}{\iota + q_0 - 2\iota q_0} \right]
\end{aligned} \tag{3.22}$$

The general procedure to prove Proposition 5 is provided in Appendix at the end of this Chapter.

Proposition 5 shows that, given other exogenous values of the model, a (pure) strategy of manipulation is optimal in the first period only if the uncertainty level is high in the market. The intuition is that, under this circumstance, the hedger is very likely to believe



that the large trader is the type I even if he observes a higher previous delivery price, because she knows that other exogenous factors may very likely contribute to that price, and therefore, the hedger in the second period may still have incentives to hedge actively.

**Example 3** This example is to show the result of proposition 5 intuitively. Assume that  $a = 0.32, b = 0.08, M = 25, N = 8, q_0 = 0.95$ . We wish to find the critical value of certainty level  $\iota^*$  such that for any  $\iota < \iota^*$  the equation value is strictly less than zero, i.e., pure strategy of manipulation dominates other strategies. We can solve the equation numerically and get the values of  $\iota^*$ . By solving the above equation, we have  $\iota_1^* = 0.946$  and  $\iota_2^* = 0.66$ . For some values of  $\iota$ , where  $\iota \in (0.66, 0.946)$ , the pure manipulation strategy is optimal for the large trader. This is shown in Figure 3-2.

### 3.5 Conclusions

This chapter has attempted to examine a dynamic commodity futures manipulation game with incomplete information. The purpose of this model is to find out how manipulation occurs in a market with other traders (the hedger here) who can observe the history of the market and opt to stay out of the market. The basic result of this simple analysis is that, a manipulator in order not to destroy the market must mimic the behaviour of a speculator to some extent at the initial period. The actual probability of manipulation is then determined by the hedger's initial beliefs on the large trader's type and the level of uncertainty of the market. As long as the probability of manipulation is positive, the manipulator can benefit in both ways and hedgers lose money consistently, which coincides with Kyle's finding (see Kyle 1984, pp.141-142). When the prior probability of manipulation is low, he can manipulate and make profits; when a manipulation is considered to be likely by hedgers, the large trader can speculate and makes profits by capturing the premia of the futures price over the (expected) cash price. This result is endogenous in our model - by contrast, Kyle's finding holds only under his strict informational assumption.

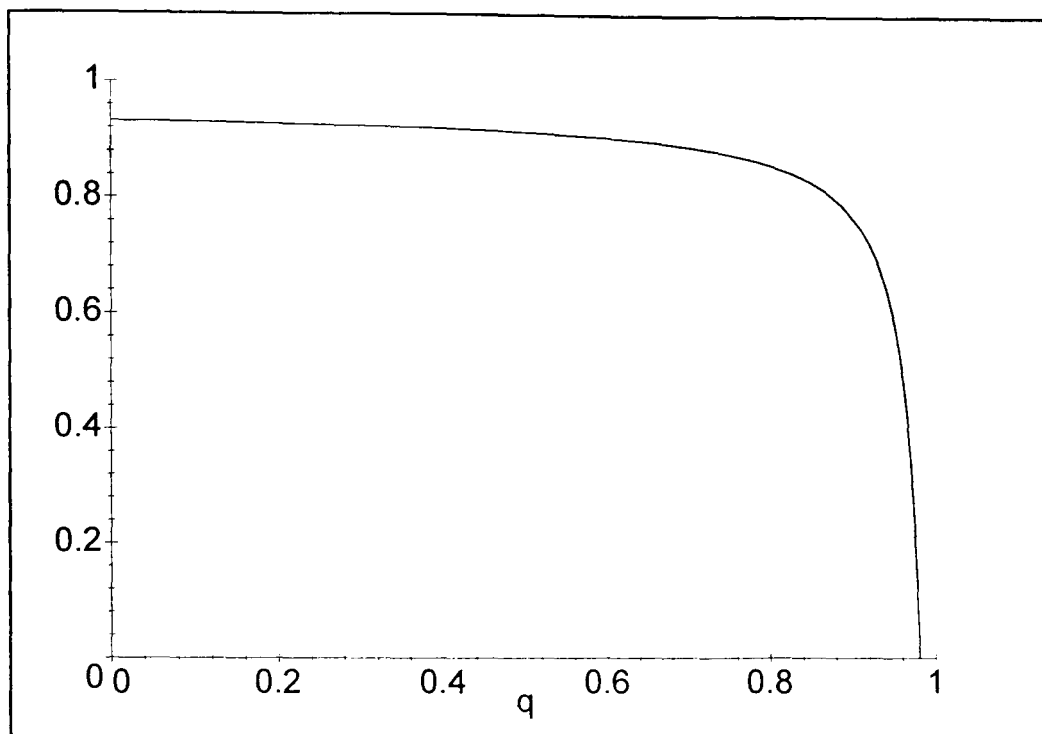


Figure 3-1: The relationships between prior probability and the level of randomization

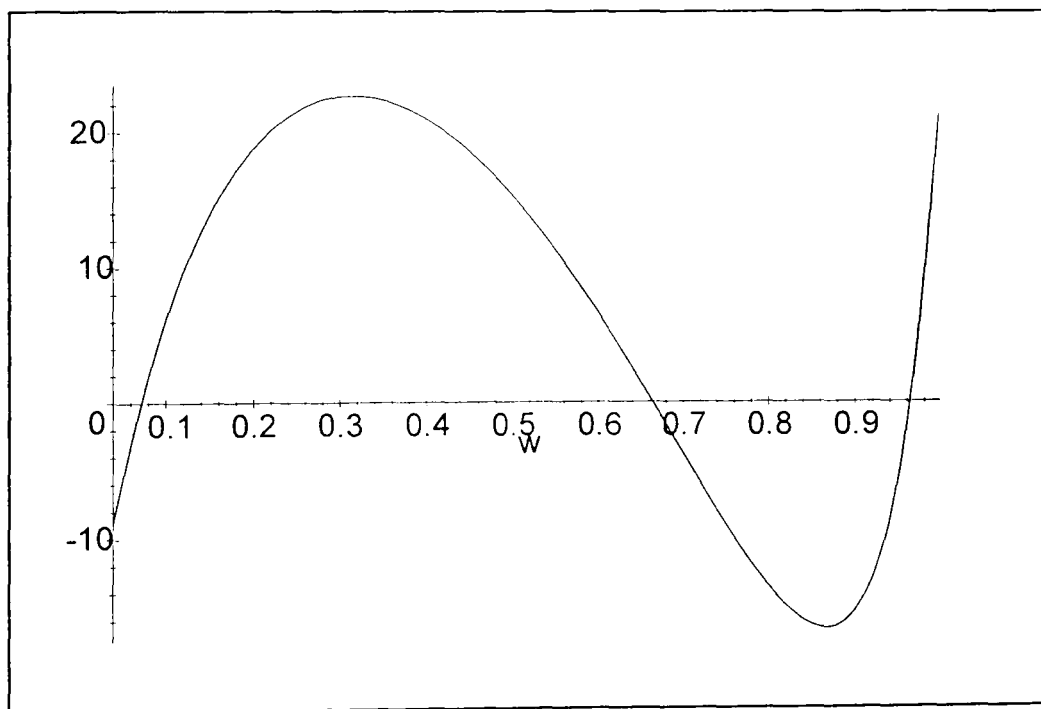


Figure 3-2: The relationship between the certainty level of a market and (pure) strategy of manipulation

Manipulation affects the accuracy of price discovery and hedging activities. In particular, the main types of manipulation that we concern here, futures cornering or squeezing, push the equilibrium futures price higher than the competitive price even when there is no actual manipulation.

This result also has implications for financial regulators. If manipulation is not exceptional in commodity futures markets and does influence the functioning of futures markets in the ways indicated, anti-manipulation policy should be one of the major regulatory concerns in futures (derivatives) regulation. This is the subject of Chapter 5.

Another interesting result from our model is that, the uncertainty in a market can constrain the large trader's behaviour to a certain degree so that he will behave less aggressively compared with the result we derived from Chapter 2, since the large trader has to take this risk into account when he makes his trading decisions. It may justify certain existing regulatory measures with the purpose to increase the risk of manipulation, such as trading halts, trading for liquidation only, increase of maintenance margins for long (or short) position holders, arbitrary cash settlement, etc.

This investigation is preliminary, concentrating on characterizing how a large trader takes advantage of his private information on his own types to manipulate a market in a sequential trading game. We simplify the analysis by ignoring the manipulator's cash market decision-making problems, such as delivery taking, burying the corpse, etc., which is an essential part of an actual "squeeze" or "corner". These issues were considered in Chapter 2.

## Appendix:

**Proof.** *of Proposition 1:*

To prove Proposition 1, we simply check that whether the prior beliefs are sufficiently high such that the hedger's hedging interests exceed the deliverable stocks at the end of period 0.

Given each trader's rational behaviour and other exogenous parameters, the hedger and the type II large trader decides their optimal futures positions ( $h_0$  and  $m_0$ ) by maximising their expected utilities respectively. Their maximising problems are as follows:

for the hedger

$$E^h(U_0) = ZE^h(\tilde{p}) + h_0(f - E^h(\tilde{p})) - 0.5\lambda Var[ZE^h(\tilde{p}) + h_0(f - E^h(\tilde{p}))]$$

for the manipulator

$$E^m(U_0) = m_0(E^m(\tilde{p}) - f_0) - 0.5\kappa Var[m_0(E^m(\tilde{p}) - f_0)]$$

Optimisation of each trader's expected utility problem yields:

the hedger's optimal hedge at  $t = 0$ :

$$h_0 = Z + \frac{f_0 - E^h(\tilde{p})}{\lambda\sigma_\epsilon^2}$$

and the manipulator's optimal futures position at  $t = 0$ :

$$m_0 = \frac{E^m(\tilde{p}) - f_0}{k\sigma_\epsilon^2}$$

where  $E^h(\tilde{p}) = P(.) - (\tilde{\theta} + \iota q_0 - q_0 \tilde{\theta})(P(.) - p(.))$  and  $E^m(\tilde{p}) = \iota P(.) + (1 - \iota)p(.)$ .

The equilibrium futures price when the large trader attempts to manipulate subject

to the market clearing condition  $h_0 + m_0 + \eta = 0$  at  $t = 0$  is given by:

$$f_0 = \frac{\lambda[\iota P(.) + (1 - \iota)p(.)] + \kappa[P(.) - (\tilde{\theta} + \iota q_0 - q_0 \tilde{\theta})(P(.) - p(.))]}{\lambda + \kappa} - \frac{(Z - \eta)\lambda\kappa\sigma_\varepsilon^2}{\lambda + \kappa} \quad (\text{A.3.1})$$

Substitute the equilibrium price and the hedger's expected delivery price to the above hedge's optimal hedge function, the hedger's optimal hedge becomes:

$$h_0 = \frac{\lambda Z + \kappa \eta}{\lambda + \kappa} + \frac{\lambda(\tilde{\theta} + \iota q_0 - q_0 \tilde{\theta} + \iota - 1)(P(.) - p(.))}{(\lambda + \kappa)\sigma_\varepsilon^2} \quad (\text{A.3.2})$$

From equation (A.3.2), given other parameters, the hedger's hedge increases monotonically with the total risk exposure and the prior beliefs that the large trader is the type I. Set equation (A.3.2) equal  $X$ , and rearrange the equation, we get the critical value of  $q_0$  as in equation (3.3). ■

**Proof.** of *Proposition 2*:

We wish to derive the large trader's optimal strategy at  $t = 0$  given the prior beliefs and the certainty level of the market. As the first step, we have to evaluate the large trader's utilities given that both the large trader's and the hedger's strategies are optimal.

Assume that the type II large trader plays a random strategy of manipulation with probability of  $1 - \tilde{\theta}$  at  $t = 0$ , then the hedger's expected price is  $E_0^h(\tilde{p}) = P(.) - [\tilde{\theta} + \iota q_0 - q_0 \tilde{\theta}][P(.) - p(.)]$ . Given her expectations, the hedger will maximise her utility by choosing a futures position. This implies maximisation of :

$$E_0^h(U_0) = ZE_0^h(\tilde{p}) + (f_0 - E_0^h(\tilde{p}))h_0 - 0.5\lambda Var[ZE_0^h(\tilde{p}) + (f_0 - E_0^h(\tilde{p}))h_0] \quad (\text{A.3.3})$$

where  $E_0^h(U_0)$  is the hedger's expected utility for period 0 given her prior beliefs regarding the large trader's type.

If the large trader speculates, he chooses an optimal amount of position  $s_0$  by maxi-

mizing his expected utilities, which are given by:

$$E_0^s(U_0, E_0^h(\tilde{p})) = [\iota p(.) + (1 - \iota)P(.) - f_0]s_0 - 0.5\rho Var\{[\iota p(.) + (1 - \iota)P(.) - f_0]s_0\} \quad (\text{A.3.4})$$

where  $E_0^s(U_0, E_0^h(\tilde{p}))$  is the speculator's expected utility for period 0 given the hedger's expectations.

If the large trader manipulates, he chooses an optimal amount of position  $m_0$  by maximizing his expected utilities, which are given by:

$$E_0^m(U_0, E_0^h(\tilde{p})) = [\iota P(.) + (1 - \iota)p(.) - f'_0]m_0 - 0.5\kappa Var\{[\iota P(.) + (1 - \iota)p(.) - f'_0]m_0\} \quad (\text{A.3.5})$$

where  $E_0^m(U_0, E_0^h(\tilde{p}))$  is the manipulator's expected utilities at period 0 given the hedger's expectations.

Maximisation of equation (A.3.3) and (A.3.5) subject to the first period market clearing condition  $s_0 - h_0 + \eta = 0$  yields:

the optimal position for the large trader:

$$s_0 = \frac{\iota p(.) + (1 - \iota)P(.) - f_0}{\rho\sigma_\epsilon^2}$$

the optimal position for the hedger:

$$h_0 = Z + \frac{f_0 - [P(.) - (\tilde{\theta} + \iota q_0 - q_0\tilde{\theta})(P(.) - p(.))]}{\lambda\sigma_\epsilon^2}$$

the equilibrium futures price for period 0 is:

$$f_0 = \frac{\lambda[\iota p(.) + (1 - \iota)P(.)] + \rho[P(.) - (\tilde{\theta} + \iota q_0 - q_0\tilde{\theta})(P(.) - p(.))]}{\lambda + \rho} - \frac{(Z - \eta)\lambda\rho\sigma_\epsilon^2}{\lambda + \rho}$$

Substitute  $s_0$  and  $f_0$  back to equation (A.3.4), the large trader's expected payoffs for

the period (if he is the type I) are therefore,

$$E_0^s(U_0, E_0^h(\tilde{p})) = \frac{\rho}{2(\lambda + \rho)^2 \sigma_\epsilon^2} ((1 - q_0)(\tilde{\theta} - \iota)(P(\cdot) - p(\cdot)) + (Z - \eta)\lambda\sigma_\epsilon^2)^2 \quad (\text{A.3.6})$$

Following the same procedures as the above by maximizing of (A.3.3) and (A.3.5) subject to the first period market clearing condition, we have the large trader's expected payoffs for the period (if he is the type II):

$$E_0^m(U_0, E_0^h(\tilde{p})) = \frac{\kappa}{2(\lambda + \kappa)^2 \sigma_\epsilon^2} ((\tilde{\theta} + \iota q_0 - q_0 \tilde{\theta} - 1 + \iota)(P(\cdot) - p(\cdot)) + (Z - \eta)\lambda\sigma_\epsilon^2)^2 \quad (\text{A.3.7})$$

The large trader's problem is to maximise his utility by choosing the optimal level of randomisation  $\tilde{\theta}^*$ . This is to maximise his expected utility holding the hedger's expectations fixed:

$$E_0(U_0, E_0^h(\tilde{p})) = \tilde{\theta} E_0^s(U_0, E_0^h(\tilde{p})) + (1 - \tilde{\theta}) E_0^m(U_0, E_0^h(\tilde{p})) \quad (\text{A.3.8})$$

The first order condition of equation (A.3.8) with respect to  $\tilde{\theta}$  yields:

$$a[(1 - q_0)(\tilde{\theta} - \iota)M + N]^2 - b[((1 - q_0)(\tilde{\theta} - \iota) + 2\iota - 1)M + N]^2 = 0 \quad (\text{A.3.9})$$

where  $a = \frac{\rho}{(\lambda + \rho)^2}$ ,  $b = \frac{\kappa}{(\lambda + \kappa)^2}$ ,  $M = P(\cdot) - p(\cdot)$ , and  $N = (Z - \eta)\lambda\sigma_\epsilon^2$ .

Write  $(1 - q_0)(\tilde{\theta} - \iota) = V$ , and assume  $a > b$ , the above equation can be simplified to be:

$$(a - b)(VM + N)^2 - (2\iota - 1)b[2VM^2 + (2\iota - 1)M + 2MN] = 0$$

By solving the equation above, we have

$$(1 - q_0)(\tilde{\theta} - \iota) = -\frac{N}{M} + \frac{(2\iota - 1)}{a - b}(b - \sqrt{ab - b^2})$$

or equivalently,

$$\tilde{\theta} = \iota - \frac{1}{1 - q_0} \left( -\frac{N}{M} + \frac{(2\iota - 1)}{a - b}(b - \sqrt{ab - b^2}) \right)$$

■

*The procedure to prove Proposition 5:*

The proof of proposition 5 is not difficult but slightly tedious. We describe the general procedure of the proof and do not intend to go into details here. A pure strategy of manipulation implies  $\tilde{\theta} = 1 - \iota$ . Substitute  $\tilde{\theta} = 1 - \iota$  into equation (3.21), and let the value of the equation less than zero. Rearranging it, we can get equation (3.22).



# Chapter 4

## The Economic Effects of Futures Manipulation: An Empirical Analysis

### 4.1 Introduction

It is important to understand the effects of manipulation in order to define manipulation, to measure the costs of manipulation, and to frame anti-manipulation legislation. Although several theoretical models investigated how futures manipulation could occur in equilibrium, such as Anderson and Sundaresan (1984), Newbery (1984), Kyle (1984), Jarrow (1992), Kumar and Seppi (1992), Pirrong (1995b), etc., we have not been able to find a comprehensive theory to analyse the effects of manipulation. Pirrong (1993, 1994) employed microeconomic theory to demonstrate how manipulation affects prices, consumption, wealth distribution, storage and price relations, and argued that it is possible to resort to classical statistical methodology to test these effects explicitly. His derivation of the economic effects of manipulation is, to my knowledge, the first rigorous demonstration on this issue by using standard economic theory. However, these effects themselves are not new findings, and there has been controversies throughout the long

history of US manipulation case laws. Empirical studies of manipulation effects are few. Williams (1995) provided a detailed economic analysis of the Hunt silver case based on its *ex post* effects. *Minpeco v. Hunt* case was unusual and interesting since the Hunt silver case was one of the most serious manipulation cases in the history of US futures trading, and the manipulation trial mobilized nine well-known economists as expert witnesses to give testimony on the aspects of defining the offence, determining the causal connection, and inferring intent. However, experts' testimony on whether the silver price was artificial and whether Hunt caused that price was apparently conflicting, which once again showed that debates on the effects of manipulation have not been resolved. More recently, Barnhart, Kahl and Barnhart (1996) analysed some aspects of effects of the July 1989 soybean futures manipulation on the CBOT, and found that price and spread behaviour at the period of alleged manipulation were significantly different from these in other periods.

We try to avoid getting involved in historical debates on testing manipulation effects, and instead, to argue more generally the economic effects of manipulation based on the theoretical models discussed in the previous two chapters, although the focus of those there was mainly on equilibrium analysis. One of the most important results we obtained from the models is that, the key to a successful manipulation is essentially that the large trader manipulates other traders' beliefs. The implications are that, manipulation may affect other traders' expectations, and thereby the equilibrium pricing processes. Long manipulation typically discourages hedging. Thus, the proper functioning of futures markets is impaired. More specifically from our models, given other market conditions, when a manipulation is considered to be very likely in a market, hedgers will hedge less and the large trader will choose to speculate, such that the futures price falls beneath the competitive level at contract maturity; while in the converse case, hedgers will hedge actively, and the large trader may choose to manipulate, with the result that the futures price for the manipulated contract exceeds the competitive level. Futures prices will therefore appear to be subject to systematical forecast errors (futures price less future

cash price) in the presence of manipulation. Under these circumstances, hedging is discouraged not only because hedgers lose money consistently, but also because they will expect a higher delivery price as long as there is a positive probability of manipulation in equilibrium. They will therefore hedge less or even go long, and the optimal hedging ratio will be less than that without manipulation. Furthermore, the hedging effectiveness is adversely affected, since hedgers are not able to predict basis behaviour anymore in the presence of manipulation.

Based on these views, in this chapter we attempt to search the economic effects of futures manipulation empirically. We choose the London Metal Exchange (LME) as our object of analysis, because the LME copper market was believed to be subject to frequent manipulations, especially by the Sumitomo Corporation of Japan from possibly as early as the middle of 1980s to June 1996. Therefore, we are able to construct elegant time-series to test the hypotheses of manipulation effects implied by our theoretical models.

The rest of this chapter is organised as follows. We begin with a brief introduction of the Sumitomo copper manipulation in section 4.2. Section 4.3 analyses how manipulation may affect the functioning of futures markets. In section 4.4, we examine the effects of manipulation on the price discovery function of futures markets and use LME data to test whether futures price becomes a biased estimate of the future cash price and the futures price forecast error with manipulation is positive in the presence of manipulation. Section 4.5 employs two widely accepted models to analyse manipulation effects on the risk shifting function of futures markets and use LME data to test the models developed in study. In section 4.6, we investigate the effects of the alleged Sumitomo manipulation on the LME cash price. The final section contains a brief conclusion.

## 4.2 The Sumitomo Copper Manipulation

On May 11, 1998, the Commodity Futures Trading Commission (CFTC) announced that it had reasons to believe that Sumitomo manipulated the copper market through actions

taken on the LME in 1995 and 1996, which violated sections 6(c), 6(d) and 9(a)(2) of the Commodity Exchange Act (CEA), and ordered the company to cease and desist from further violations of those provisions of the CEA and to pay a total of \$150 million as a civil monetary penalty. In August 1998, Sumitomo offered \$99 million to settle 6 lawsuits in New York. Although Sumitomo itself neither admitted nor denied these manipulative activities, the implication of its offers of settlement was clear.

Sumitomo has been involved in marketing of copper metal for several hundred years. Its copper metals business is conducted by the Copper Metals Team of the Non-Ferrous Metals Department, whose responsibilities include supplying copper to customer (primarily in Japan and Pacific region), and using futures and other derivatives markets to hedge price risk. The hedging activity is mainly through the LME, the major world futures markets for all non-ferrous metals, and the commodity exchange division of the New York Mercantile Exchange (Comex). Historical evidences suggest, in addition to the 1995 and 1996 manipulation, Sumitomo may have manipulated opportunistically the world copper market since 1991, possibly since as early as the middle of 1980s (Gilbert 1996) until the end of May or early June 1996, when head of the copper team was “reassigned” and US and Canadian-based hedge funds as well as other investors attacked the inflated copper price which fell from around \$2800/tonne to below \$2000/tonne shortly after his reassignment. Sumitomo initially estimated a loss of \$1.8 billion, subsequently revised up to \$2.6 billion.

The Sumitomo copper manipulation appears to have been one of the largest in the history of futures trading, in terms either of size or of duration. Although it may also have involved complex strategies, diverse instruments and markets (futures, options, OTC, and cash markets), the Sumitomo manipulation exploited classic “corners” or “squeezes” (as discussed and modeled in the previous chapters). Typically Sumitomo exploited the delivery mechanism of the LME copper contract, buying futures (options), controlling deliverable supplies and taking or threatening to take delivery when contracts approach maturities and then rolled market squeezes over. It is alleged that Sumitomo

took these actions for the purpose of creating artificially high absolute prices and artificial backwardations (premiums of nearby contracts or cash prices over more distant contract prices), and exploited these artificially high prices to profit from liquidations of its large futures positions and holding of LME warrants, and took advantage of these artificial backwardations to profit from rolling squeezes over or lending forward. Creating and sustaining backwardations facilitated the intermittent manipulation strategies almost over 10 years. It is also alleged that Sumitomo manipulated the world copper market over the decade 1987-96, certainly over the period of 1991-96 (Gilbert 1996, p.1). In a 'natural' backwardation market, it is cheaper and less riskier to sustain backwardations over a longer period of time, since a strategy of rolling over short-dated positions forward yields rollover gains. However, in a contango market, creating backwardations involves huge resources and larger risk, and this requires to buy futures, take substantial deliveries and pay losses and variation margins on rolling contracts over, since a trader would be forced to purchase deferred month futures at higher prices than the prices it could sell these contracts for as they approach expiration.<sup>1</sup>

The Sumitomo copper manipulation appears to have been advised and implemented by its chief copper trader, Mr. Hamanaka, who was made head of the copper team at the non-ferrous metal division in August 1987. In conjunction with others, his appointment coincided with Sumitomo's increasing frustration at its inability to profit from physical metal, which led the company to use futures and derivatives extensively.<sup>2</sup> During 1987 - 1989 the LME copper market generally exhibited acute backwardations (see Figure 4-3 and Figure 4-4), which facilitated Sumitomo, acting as a copper supplier, to profit even from relatively simple trading strategies, such as by buying futures and selling against backwardations, or by buying futures, taking delivery and supplying cash copper to its customers, etc. Since under these circumstances, the immediate delivery (nearby

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<sup>1</sup>Markets in which nearby prices are above deferred-month prices are commonly referred to as backwardation markets. Markets in which nearby prices are below deferred-month prices are generally referred to as contango markets.

<sup>2</sup>The Trader Who Beat the World's Markets - and then Lost It All. The *Financial Times*, 28 June 1996.

contract) gets a higher price than does a deferred contract. The possible profitability was clear from the company president's award on the profitability of the non-ferrous division in its 1991 annual report (see also footnote 2). It is also possible that Sumitomo occasionally squeezed the LME and realised substantial profits, although it did not take significant deliveries over that period. But backwardations can provide little direct evidence of manipulation in this situation, since it is difficult to distinguish *ex post* between high spot premiums arising from supply shocks and those resulting from manipulation.

From 1990 to 1993, metals were in over-supply in the face of relatively slack demand growth, and the LME copper market in general was in contango. In order to support copper cash prices, Sumitomo appears to have manipulated intermittently. For example, in October 1991 it was reported that Sumitomo controlled the majority of the LME's London warehouse stocks, which led to the intervention in the market of the LME chief executive in November 1991; in the latter half of 1993, after a steep fall in copper price, Sumitomo apparently arranged a large buy order to push up copper prices and create large backwardations (the cash/three month backwardation at a time was more than \$80 per tonne) which led to the LME emergency action that limited daily backwardation to \$5 per tonne on September 8, 1993 (see appendix A for relevant summarised news reports from financial press).

It was unclear from the market performance whether or not Sumitomo manipulated in 1994. It was alleged that in January and February of 1994 Sumitomo had large purchase activities which forced the Codelco, a Chilean state-owned company to take a huge loss. It is also suspected that Sumitomo may have attempted to manipulate from circumstantial evidence, for example, entering purchase agreements with a New York based US copper merchant that contained unusual minimum price and price participation provisions in June 1994. From late 1993, Sumitomo engaged in an unprecedented volume of copper put and swap transactions which provided financing and also supplied Sumitomo with another large financial incentive to force copper prices to higher levels.<sup>3</sup> However, it

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<sup>3</sup>It is alleged that from late 1993 Sumitomo engaged swap transactions with Chase Manhattan Bank

seems likely that Sumitomo was running a large long position (in cash market or both in cash and futures market) over this period and may have not undertaken a squeeze, and therefore, failed to realise profits. From the latter half of 1994, demand growth in the world copper market started to slacken. This left Sumitomo with a large long position in the market which was prone to price fall, and made manipulation more expensive and riskier.

In order to support prices and sustain backwardations from the end of 1994, Sumitomo acquired larger cash position or take larger futures position, or both. This forced Sumitomo subsequently to realise substantial losses from these operations. In Sumitomo's Merrill Lynch account, it held 78,000 tons of the copper in LME exchange warehouses at the end of March, 1995, which amounted to approximately 32% of the total LME stocks. According to the CFTC's Order announced on May 11, 1998, Sumitomo, together with the announced US copper merchant, owned and controlled approaching 100% of LME stocks at various times in the fourth quarter of 1995 and also maintained large and controlling LME futures positions. Under these circumstances, Sumitomo's position became more vulnerable and the manipulation scheme became more exposed to the public which prompted inquiries at the end of 1995 initiated by the LME, the Securities and Investment Board (SIB, later became the Financial Services Authority or FSA in October 1997) (in May 1996), the principal UK financial market watchdog, and the CFTC, the US futures market regulator. Pressures from LME and regulatory authorities forced Sumitomo to remove Mr. Hamanaka from day-to-day trading in the middle of May, and the manipulation scheme eventually collapsed at the end of May and the early June of 1996 resulting from intense speculative attacks by US hedge funds and the large Canadian speculator Herb Black.

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N. A. pursuant to which Sumitomo effectively borrowed approximately \$500 million in order to finance Sumitomo's manipulation of copper exchange contract prices; it also engaged in extraordinary copper and gold swap transactions and selling large quantities of copper and gold puts to J. P. Morgan. These transactions financed Sumitomo's manipulative activities (estimated in excess of \$300 million) and resulted in disciplinary action by the Federal Reserve Board against J. P. Morgan, etc. See *In Re Sumitomo Copper Litigation*, 96 Civ. 4584, New York, pp.26-27.

### 4.3 Futures Manipulation and the Functions of Futures Markets

The CFTC Order asserted that the Sumitomo manipulation had three types of effects on copper prices and markets: artificially high copper prices; distorted price relationships between cash and forward prices; and distorted price relationships between the LME and the US copper cash and futures markets. However, the CFTC did not provide detailed evidence. Although we do not intend to discuss the legal aspects of the CFTC case, assertions of this sort have been subject to controversies in the long history of US manipulation case laws,<sup>4</sup> in which it has been argued that it is almost impossible to establish testable criteria for price “artificiality” or artificial price relationships. Indeed, these types of evidence sometimes failed to be persuasive, for example, in the Cox case.<sup>5</sup> This view was intensified in the Hunt silver case (Williams 1995). It is not our intention to comprehensively investigate the effects of the Sumitomo manipulation here. Instead, we concentrate on testing the results implied in our theoretical models, i.e., whether manipulation affects adversely the economic functions of futures markets, namely “price discovery” and “risk shifting”.

The adverse effect of manipulation on price discovery is that manipulation may interfere with the ability of a futures market to provide a useful price discovery tool. In other words, manipulation may cause producers and consumers to make incorrect price forecasts based on current futures prices, and as a consequence, unwise production or

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<sup>4</sup>The earlier case involving the debates on price relationships dated back to *Peto v. Howell*, which was brought under the Sherman Act in July 1937. Later cases involved price artificiality and price relationships included *Greater Western Food Distributions Inc. v. Brannan*, *Volkart Brothers v. Freeman*, *Cargill v. Hardin*, etc.

<sup>5</sup>In establishing price “artificiality”, the courts used in several cases the historical price comparisons (including spreads), such as in *Great Western Food Distributions Inc. v. Brannan*, *Cargill v. Hardin*. Because courts could not have set up a criterion on how large a deviation from typical price relations constitutes price “artificiality”, and this kinds of evidence therefore even did not persuade the CFTC commissioners, which led the court to ignore historical comparisons altogether in Cox. The CFTC commissioners then concluded: “the prospective behaviour of a normal market is not necessarily bounded by the market’s historical experience”. See Cox, [1986-1987 Transfer Binder] Comm. Fut. L. Rep. (CCH) 23,768, at 34, 064 (July 15, 1987).



investment decisions.

The forecast mechanism works through the relationship between futures price and the expected future cash price. Futures markets serve society by providing a mechanism for market agents to form expectations about future cash prices. Some researchers start from the premise that the futures price equals the expected future cash price, i.e., the current futures price will be an unbiased predictor of the future cash price - the futures price will convey all information currently available to market participants or observers, thus, production or consumption decisions made on the basis of current futures prices will be socially optimal. However, the dominant view on the relationship between futures prices and the expected cash prices has been that the two are in general not equal. The most usual situation is that the futures price is below the expected cash price, which is termed the Keynes-Hicks hypothesis of “normal backwardation”. This theorem originated with John Maynard Keynes more than 60 years ago, as he put it: “In other words, the quoted forward price, though above the present spot price, must fall below the anticipated future spot price by at least the amount of the normal backwardation”.<sup>6</sup> The Keynes-Hicks hypothesis takes speculators as being net long and hence hedgers as net short, and the difference between futures price and the expected cash price is the risk premium which induces speculators to absorb the price risk transferred by hedgers, which is referred to be a negative bias or forecast error in futures price. In this situation, if producers and consumers use the futures prices to predict the future cash prices, the forecasts will not be optimal. Nevertheless, optimality may be achieved if futures prices are adjusted for the expected biases (Edwards and Edwards 1984, p.346).

Keynes-Hicks theory does not incorporate diversification opportunities. Some more recent models, for example, Dusak (1973), Grauer and Litzenberger (1979), Bodie and Rosansky (1980), Breeden (1979, 1980), etc., have studied the question of a risk premium within the CAMP. Within these models the risk premium required on a futures contract does not depend on the variability of futures prices, but on the degree to which futures

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<sup>6</sup>Keynes J.M., *A Treatise on Money*, Vol.2, London: Macmillan, 1930.

price changes are related to the normal returns on the market portfolio. The results from Dusak (1973) and Bodie and Rosansky (1980) indicated that futures prices bear no systemic risk. Breeden (1979, 1980) proposed that backwardation would occur if random spot price at maturity is positively related to real aggregate consumption, and found that some futures contracts have significant systemic risk which would result in a risk premium. Grauer and Litzenberger (1979), and Richard and Sundaresan (1981), and several hedging models, such as Anderson and Danthine (1981), confirmed the existence of a risk premium in futures markets.

Our Bayesian game-theoretic models with incomplete information, as developed in the previous chapters, predicted that in the presence of manipulation the futures price is a biased estimate of the future cash price from the point view of all market participants except market makers, although the severity of the bias may differ for different types of traders (hedgers and the large trader). When a manipulation is not considered to be very likely by the hedger and market makers, i.e., their beliefs on the probability of manipulation are low, the large trader may establish a huge long position at lower prices, and profitably manipulates as the contract approaches maturity. The futures price is therefore, below the large trader's expected cash price, and should rise over time by contract expiration; while a manipulation is considered to be very likely by other market participants, the large trader will typically short futures instead of undertaking a manipulation, and the futures price will therefore be above the large trader's expected cash price, and should decline to the competitive price level at delivery. The large trader makes profits both ways. Actually, this two scenarios are closely related in practice, and the relationship between the futures price and the expected future cash price for the manipulator in the presence of manipulation is as follows: futures price is below the expected cash price for the manipulated contract; while the futures price is above the expected cash prices for other contracts simultaneously traded on the exchange.

It is sometimes alleged that manipulation usually takes place at the end of delivery month, and usually exists only for a short period of time, and therefore, the effects on

immediate production or consumption decision-making may be not substantial, because people using futures prices for decision-making purposes typically have a decision horizon longer than several days or weeks (Edwards and Edwards 1984, p.346; Johnson 1987, p.747). But this argument does not hold when we consider the effects of manipulation on other traders' expectations, and therefore the price formation processes of other contracts on the same commodity traded on the same exchange or other exchanges, especially when markets are subject to frequent manipulations. Manipulation may permanently distort the relationships between futures price and the expected cash price. These effects may be substantial (the magnitude of distortion depends on the delivery market characteristics, how often manipulation occurs and how government or exchanges regulate the market). The equilibrium futures price will be changed as a result of manipulation. We show (Chapter 2) that it will be a weighted average of the expected marginal cost of delivery and the competitive price, where the weight depends on market makers' posterior probability that the large trader is a manipulator. Obviously, it is higher than that without manipulation as long as there is a positive probability of manipulation and the supply of deliverable stocks in the delivery market is less than perfectly elastic. Since there are more uncertain factors introduced into the price formation process, there will be an increase in variances of futures and cash prices. Therefore, in the presence of manipulation, it is difficult for people to adjust the futures price for the ordinary expected bias to achieve optimal forecasts, and hence manipulation has adverse effects on the accuracy of price discovery.<sup>7</sup>

The LME trading structure and trading practice are significantly different from those of a standard futures market in many aspects. In particular, it has a daily contract structure, resulting in a large number of contracts (approximately 81 contracts per metal each day); the practice of borrowing and lending; a large number of large traders. These may have important implications on the vulnerability of a futures market to manipulation.

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<sup>7</sup>Our argument is different from that of Edwards and Edwards (1984), who argued that, with stochastic but predictable probabilities of manipulation price discoverers could still effectively rely on futures prices to predict expected cash prices, but the variance in the error of this prediction will increase.

The daily contract structure with a few officially reported prices (official price accessible to public only relate to cash, 3 month, 15 month and 27 month, closing price are available for some other contracts (1, 2, 6, 9, 12 months) limits the market transparency in the LME. This may facilitates a manipulator in concealing relevant information, and additionally, daily expiration of contracts facilitates the manipulator concealing the information of which contract is manipulated because at least several contracts share the same information of deliverable stocks at expiration. The practice of borrowing and lending can extend the manipulation effects to other contracts and longer periods. For example, lending could transmit these high price forward by sale of a near date and simultaneous purchase of a date further forward for a long position holder, and similarly, by purchase of a near date and simultaneous re-selling of a date forward for a short position holder. These may suggest that the LME is more prone to manipulation than a standard futures markets, and more important, manipulation on the LME can have far more devastating effects than that on a standard market.

Manipulation discourages hedging activities, and may affect the risk-shifting function of a futures market. The effect of manipulation on the risk-shifting of a futures market works through its effects on the basis, especially basis risk. The temporal basis refers to the current cash price of a particular commodity at a specified location minus the futures price of the same contract for the same commodity. The basis is uncertain from the time when a hedge is made to the time when it is removed, and this gives rise to basis risk (Hull 1993, pp.33-36). For most futures markets, when the futures contract is at expiration, the futures price and the spot price of the contract must be the same (without transaction costs), i.e., the basis must be zero. The LME is different, since LME contracts have daily expiry dates, and trading is concentrated on the cash and three month contracts, so that effectively a new futures contract is traded each trading day. As a consequence, we are not able to isolate the convergence characteristic of the basis from publicly available LME data, but basis risk still exists. The effective price a hedger obtains is the futures price at the time the hedging is made plus the basis at the

time the hedger closes out her contracts. For a short hedger on a backwardation market, if the basis has unexpectedly strengthened, her position worsens; whereas if the basis has weakened unexpectedly, her position improves.

Basis risk arises, firstly, in the case in which a commodity, the price of which is to be hedged, may not correspond exactly to the asset underlying the futures contract; and secondly, the hedger may be uncertain as to the date when the asset will be bought or sold. Basis risk is therefore important for most hedgers because few commodities have exactly matching futures contracts which would give as perfect hedges (Anderson and Danthine 1981, p.1183). In the case of perfect hedges, short hedgers will not suffer seriously from manipulation in terms of real financial losses, but manipulation increases their costs of hedging. A hedger's cost may be defined in terms of her opportunity cost, i.e., the difference between the futures price and the cash price she would have paid or received had she not hedged. If manipulation raises futures prices, cash prices or both to "artificial" levels, a short hedger will suffer opportunity losses in the presence of manipulation. If the physical commodity or the date the hedger buys or sells a commodity differs from the characteristics of the futures contract, manipulation may worsen the hedger's position, and additionally, it may expose the hedger to a greater basis risk. The worsening of her position results from the fact that, on a delivery-settled market, in the presence of manipulation, the short has either to acquire the already over-valued commodities from the long or to close out her positions at a substantial premium, in which cases, the short suffers real financial losses. Common measurements of basis risk are basis volatility and hedging effectiveness. Historical experiences suggest that, manipulation usually makes the basis more volatile, and as suggested by Edwards and Edwards (1984), and this may alter the effectiveness of a hedge. With basis risk, a common definition of hedging effectiveness is the degree to which the futures price and the cash price are correlated. The lower this correlation, the lower is the hedging effectiveness. Thus, if manipulation lowers the level of this correlation, we may conclude that it decreases hedging effectiveness (Edwards and Edwards 1984, p.349).

Furthermore, if manipulation causes hedgers to suffer higher opportunity costs, real financial losses or decreased hedging effectiveness, it will discourage hedging activities, i.e., it makes futures markets less attractive to hedgers. Manipulation may therefore harm market liquidity, especially where those markets are used primarily by commercial traders.

## 4.4 Manipulation and Price Discovery

As discussed earlier, to investigate manipulation effects on price discovery function of a futures market is essentially to see whether manipulation affects the relationship between the futures price and the expected future cash price. We use LME daily data to test this relationship for the copper market with the objective of investigating whether a positive probability of manipulation increases the futures price forecast errors (the futures price minus the future cash price), and furthermore, whether these forecast errors, in line with what our models predicted, are invariably positive for long manipulations.

### 4.4.1 Methodology and hypothesis

#### The futures price forecast error

We try to avoid getting into the difficulties associated with examining the effects of manipulation on futures price behaviour of the manipulated contracts, and instead, we investigate whether the futures price is systematically above the future cash price during the periods of alleged manipulation. Since it is more interesting to look at whether manipulation affects equilibrium futures pricing process and changes the relationship between futures price and the future cash price through its effects on other traders' expectations. If this is true, we may conclude that the effects of manipulation on "price discovery" are enormous. It not only affects the price behaviour of the manipulated contract, but also affects the pricing of other contracts, especially the pricing processes of the further nearby contracts. Therefore, we are interested in looking at whether the futures

price forecast error ( $\vartheta$ ) is positive for periods of manipulation or alleged manipulation, i.e.,

$$\vartheta = F_{0,1} - S_1 > 0$$

where  $F_{0,1}$  denotes the futures price of a contract traded at period 0 with 1 period for expiration;  $S_1$  denotes the actual cash price for the same contract at period 1.

The approach of testing futures price forecast errors is essentially similar as that of testing “normal backwardation” or market efficiency, which has been performed by many researchers (for example, Houthakker 1957; Fama and French 1987; Kolb 1992, etc.). In a classic futures market, Keynesian “normal backwardation” implies that futures price should rise over time for the contract which has specific delivery months, and the excess of future cash price over the current futures price is the reward for speculators for bearing risks. The hypothesis is therefore simplified to test whether mean daily futures returns are positive prior to contract expirations. Empirical evidences on “normal backwardation” are mixed,<sup>8</sup> and the more recent result of Kolb (1992) using a large US database, supported this view for some commodities, especially for copper. By contrast, we argue that the futures price forecast errors should be negative for the manipulated contracts when a manipulation is not initially considered to be very likely, but they become positive in the periods when other traders anticipate a high probability of manipulation. This implies that futures prices should rise until contract maturity for the manipulated contracts, but should decline over time for other contracts for the same commodity traded simultaneously on the exchange or other related exchanges. A natural difficulty in testing these hypotheses is that, it is almost impossible to know from publicly available LME data exactly which contracts are manipulated and when a manipulation starts. It is therefore more reliable to refer to financial press or other sources of information to identify the periods when a manipulation was publicly suspected. Thus, we only consider the second side of test here.

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<sup>8</sup>For a detailed description of empirical evidence on backwardations, see Kolb (1992, pp.76-78).

## Computation of mean return error

Trading practices on the LME where a new contract is traded each day, make tests of futures price forecast errors more straightforward than those on standard futures markets. Testing whether futures prices exhibit positive forecast errors is equivalent to determining whether mean futures prices are systematically above the mean future cash prices when a manipulation is publicly suspected or acknowledged. Mathematically, the average futures price forecast error can be expressed as:

$$\text{average forecast error} = \frac{\sum_{t=1}^n (F_t - S_{t+k})}{n} \quad (4.1)$$

where  $F_t$  is the futures price at time  $t$ ,  $S_{t+k}$  is the cash price at the  $k$ th period. Since we propose to use daily data to test the three month forecasting bias, hence  $k$  is 63 in this case.  $n$  represents the length which a manipulation or alleged manipulation lasts.

We choose to use the percentage difference between  $F_{0,1}$  and  $S_1$  instead of the arithmetic difference. The test then becomes out of examining whether there exists systematic positive mean return errors during the periods where manipulation is publicly acknowledged or suspected. Mathematically, the daily simple ( $\vartheta^s$ ) and log ( $\vartheta^l$ ) mean return errors are given by:

$$\vartheta^s = \frac{\sum_{t=1}^n \left( \frac{F_t - S_{t+k}}{F_t} \right)}{n} \text{ or } \vartheta^l = \frac{\sum_{t=1}^n \ln(F_t/S_{t+k})}{n} \quad (4.2)$$

## Hypothesis

The null hypothesis is formally formulated to test the impact of manipulation on the role of futures price as a tool to predict the futures cash price, i.e., the daily mean return error is not statistically significantly positive over the periods of alleged manipulation.

If the hypothesis is rejected, we may conclude that there exists positive forecast error in the periods of alleged manipulation, so that manipulation affects the futures prices



as a tool to predict the future cash prices. The effects can be interpreted as a positive probability of manipulation inducing market participants to systematically over-estimate the future cash prices. In this sense, we may claim that manipulation pushes the futures price to an “artificial” level.

#### 4.4.2 Manipulation identification

*Ex post* identification of manipulation may be conducted either through examination of its causes or of its effects. Long manipulation typically involves the creation of market power, i.e., dominant long positions in futures markets or both in futures and cash markets, which lead to an artificial shortage of deliverable supply in the delivery market, and hence artificial prices and artificial price relationships. To establish manipulation in a US court, one also needs to show the manipulator intentionally causes this “artificiality”, and the element of intentionality is normally inferred from circumstantial evidences. Accurate identification of a manipulation is therefore non trivial, since from public available information we do not have reliable information regarding a manipulator’s position and sufficient circumstantial evidence on whether the trader’s large position has intentionally influenced the copper prices or price relationships.

In identifying the alleged Sumitomo manipulation from publicly available information, we may focus on the *ex post* effects of these manipulations. Specifically, two sources of publicly available information are considered to be important. First, comparing backwardations in copper market with the deliverable stocks reported in LME warehouses. If there are serious backwardations, while the cash market supply is not considerably “tight”, then a manipulation is suspected. Second, comparing the behaviour of backwardations in copper market with that in the LME aluminium market. Since both metals are the two most liquid LME contracts, and are regarded to share broadly common consumption time paths. If copper exhibits backwardations, while aluminium does not, then a manipulation is suspected, see Gilbert (1996). In manipulation identification by comparing backwardations with deliverable stocks in the LME warehouses, we calculate the

weekly changes of copper convenience yields and the changes of deliverable stocks over July 1991 to July 1996. If the positive signs of changes of convenience yields coincide with positive signs of deliverable stocks for over 3 weeks, a manipulation is suspected. Relying on this source of information, 4 periods of manipulation stand out. These are: July 19, 1991 - December 6, 1991; August 13, 1993 - September 16, 1993; October 13, 1995 - January 19, 1996; and April 12 - June 1996. We also compare the backwardations in copper market with that in aluminium market by calculating the basis differentials (copper basis - aluminium basis), and graph it in Figure 4-7. From Figure 4-7, manipulation may be suspected over the following periods: August -December 1991; June - September 1993; May - August 1995; October 1995 - January 1996; and April - June 1996. But it is not easy to draw any conclusion on manipulative activities in 1994 and the beginning of 1995 from the relative basis behaviour since there was a large hangover of aluminium stocks resulting from Russian exports over the previous years.

Alternatively, one may look at relevant reports on manipulative activities in financial press, especially the *Financial Times*, to identify whether the LME copper market was manipulated. Since in this study our purpose here is effectively to investigate whether publicly suspected manipulation influences traders' expectations and therefore pricing processes, and price relationships, and we may therefore rely on the relevant reports and analysis from financial press (see the relevant summarised news reports in appendix A at the end of the chapter). and the two sources of information from publicly available information in manipulation identification from *ex post* effects are only used to see to what extent the suspected market behaviour conforms to the reported manipulated activities and then to determine the length of manipulation more accurately. Interestingly, we find that the reported manipulative activities are highly correlated with data-based manipulations. Based mainly on the press reports, four periods of manipulation in the LME copper market from July 1991 to the middle of 1996 are identified, which will be used in our econometric analysis throughout this Chapter. These are:

- August 2, 1991 - December 6, 1991

- August 11, 1993 - September 16, 1993
- October 13, 1995 - January 19, 1996
- April 11, 1996 - June 14, 1996

### 4.4.3 Data and results

We use daily data on LME settlement prices, 3-month futures prices and deliverable stocks from January 1991 to September 1996. Data on stocks in LME warehouses were, at that time, available only on weekly or twice-weekly basis. Data on prices are dollar prices. Prior to July 1 of 1993, prices were denominated in Sterling, and these have been converted from sterling prices to dollar prices using the official LME daily dollar-sterling exchange rate.

We calculate daily log and simple mean return errors from January 1991 to June 1996, in which period the LME copper market was regarded as having been subject to frequent manipulations by the metal trading arm of Sumitomo Corporation.

Since our sampling time interval is finer than the futures contract interval, in order to get rid of the overlapping data problem, we use the methodology suggested by Hansen and Hodrick (1980) to estimate the asymptotic variance-covariance matrix, and then calculate the modified standard deviations.<sup>9</sup> The results are reported in Table 4.1.<sup>10</sup>

We do not see any substantial differences between log and simple mean forecast errors except that the simple forecast error in 1992 is negative but positive for the log forecast error, though both are not statistically significant. We do find evidence on the effects of manipulation on the relationships between futures price and the future cash price. From Table 4.1, for all the 4 periods of identified manipulation, all the mean log and

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<sup>9</sup>The modified standard deviation ( $\bar{\sigma}$ ) is  $\sqrt{\frac{k+1}{n} - \frac{2 \sum_{i=1}^{k-1} i(k-i)}{kn^2}} \sigma$ , where  $n$  is the number of observations,  $k$  is the interval of forecasting, and  $\sigma$  the standard deviation of prediction errors. For details of derivation, see the appendix B at the end of this Chapter.

<sup>10</sup>The standard errors reported were modified by the approach proposed by Hansen and Hodrick(1980).

period	log forecast error			simple forecast error		
	mean	st.error	t-value	mean	st.error	t-value
1991-June 1996	0.0022	0.023	0.09	0.0039	0.023	0.17
1991	0.0136	0.029	0.47	0.021	0.023	0.91
1992	0.0028	0.042	0.06	-0.006	0.041	-0.15
1993	0.046	0.061	0.76	0.033	0.058	0.56
1994	-0.109	0.042	-2.54	-0.119	0.048	-2.48
1995	0.009	0.028	0.32	0.0035	0.026	0.13
Jan.-June 1996	0.102	0.091	1.13	0.016	0.081	1.45
Aug.2-Dec. 6, 91	0.043	0.023	1.80	0.047	0.020	2.33
Aug.11-Sept.16, 93	0.151	0.042	3.59	0.127	0.036	3.53
Oct.13-Jan.19, 96	0.055	0.033	1.67	0.064	0.037	1.74
Apr.11-June 14, 96	0.217	0.084	2.58	0.218	0.081	2.71

Table 4.1: Copper futures price forecast errors (January 1991-September 1996)

simple forecast errors are positive. The positive figures are large, and all exceed 3%. The largest one exceeds 20% (for the period from April 11, 1996 to June 14, 1996). All values are statistically significant at 5% (where  $t = \sqrt{n}\bar{v}/s > 1.65$ , and  $s/\sqrt{n}$  is the standard deviation,  $n$  is the number of observations).

One immediate implication is that due to the effects of manipulation on expectations, we expect that the annual mean forecast error in the year where manipulation occurred is positive or at least larger than that without manipulation. We therefore calculate the annual log and simple average forecast errors from January 1991 to the end of June 1996, and the result which is also reported in Table 4.1 supports our conjecture. Although most daily mean forecast errors are not statistically significant, we find all annual daily means with manipulation occurred during the year are positive and annual daily means without manipulation are larger than that with manipulation. Further, daily means for 1992 (simple mean) and 1994 (without identified manipulation<sup>11</sup>) are negative and the latter is statistically significant.

Our results differ from those reported by Kolb (1992). Kolb used US data from 1959

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<sup>11</sup>The CFTC alleged that Sumitomo attempted to manipulate from the third quarter of 1994. From the market performance, Sumitomo may have not undertaken manipulation in 1994, but possibly have acquired large long positions both in the futures and cash markets.

to 1988 to test the Keynes hypothesis of “normal backwardation” in futures markets, and found 52.64% of copper futures prices were below their terminal prices, and significant negative forecast errors for 50 days prior to contract expiration. We should not conclude that our results contradict Kolb’s. But we do claim in general the copper futures prices on the LME are significantly above the cash prices for the periods of manipulation or alleged manipulation.

It is customary to assume that manipulation raises both cash and futures prices and price volatilities. We do not find unequivocal evidence for the raises of futures and cash prices. Of four identified manipulations, the mean futures price during manipulation was higher than that prior to manipulation for one case, and other four cases show that mean futures prices during manipulation were even lower than those prior to manipulation.<sup>12</sup> This result may suggest not all manipulations raise absolute prices, and that relying solely on historical price comparisons as the way to establish manipulation case may not be generally reliable, because prices are determined by current and prospective fundamentals that are not necessarily limited by the historical market experiences.<sup>13</sup> The view that manipulation raises absolute prices is based on the assumption that the manipulator must profit from the liquidation of his futures positions. This assumption is not necessarily true given that a manipulator may utilise complex dynamic strategies to maximise his profits by using different instruments and markets. For example, Sumitomo, as a major copper supplier, may manipulate the copper futures market by sustaining the cash prices above a certain level, so that it can profit from supplying cash commodity to customers at a price which is higher than the competitive level, but possibly suffers a loss from futures trading alone. We also perform F-tests to see whether the mean prices during the alleged manipulation are not significantly different from those prior to manipulation for each identified manipulation. We fail to reject the hypothesis at 5% significance level

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<sup>12</sup>The validity of this statistical results is subject to the accuracy of manipulation identification and we will employ an alternative approach to examine the effects of the alleged Sumitomo manipulation on the LME copper cash price.

<sup>13</sup>A similar argument was raised in the discussions of some court cases, for example, the Cox case, see also footnote 5.

for all the four manipulations. We do not find unequivocal evidence for the elevation of cash price volatilities and increase of deliverable stocks either. It appears that the weekly cash price volatilities for all manipulation cases are raised by at least 20%, and deliverable stocks in the LME warehouses increase from 14% to more than 30% (the 1995 manipulation) during manipulation, see Table 4.2. But F-tests show that we can only reject the hypotheses of equality of price volatilities for the August - September manipulation and the October 13, 1995 - January 19, 1996 manipulation, and of the equality of deliverable stocks for the October 13, 1995 - January 19, 1996 manipulation. In Table 4.2, futures prices and cash prices are denominated in dollars, while stocks are weekly deliverable stocks announced by the LME on every Friday and the unit is million tonnes; volatilities are measured as weekly standard deviations of daily prices; the length for each period prior to manipulation was chosen as the same as that of manipulation, and therefore, the mean and standard deviation prior to manipulation were comparable to those during manipulation.

Furthermore, we find that copper cash price volatilities do not exhibit any systematic changes over the period 1981 to 1996. This suggests manipulation may affect price volatilities only in short run. We calculate both annual average monthly and weekly volatilities through the sample period, and the results are reported in Table 4.3, where the measurement of volatility is standard deviations of daily price returns, and weekly average of volatility is the mean of weekly standard deviations for the period, whereas monthly average is the mean of intra-month standard deviations for a specific period. The annual mean volatilities in the periods of manipulation (we consider in 1991, 1993, and 1995-1996) do not appear to be significantly higher either than annual average in whole sample period or than that in the 1990s. This result is in accordance with the argument made by Brunetti and Gilbert (1995).

date	mani- pula- tion	item	cash price	futu- -res price	stocks in m tones	cash volati- lity	futures volati- lity
Aug. 2 to Dec. 6, 1991	before	mean	2308	2275	0.252	0.0119	0.0138
		std.dev.			0.027	0.0038	0.0043
	during	mean	2324	2287	0.299	0.0141	0.0153
		std. dev.			0.012	0.0044	0.0045
Aug. 11 to Sept.19, 1993	before	mean	1932	1934	0.459	0.0083	0.0073
		std.dev.			0.008	0.0034	0.0041
	during	mean	1954	1915	0.515	0.0152	0.0134
		std. dev.			0.024	0.0093	0.0082
Oct.13, 1995 to Jan.19, 1996	before	mean	2982	2917	0.16	0.0133	0.0106
		std.dev.			0.032	0.0056	0.0054
	during	mean	2862	2691	0.222	0.0159	0.0112
		std. dev.			0.037	0.0063	0.0058
April 11 to June 14 1996	before	mean	2540	2516	0.336	0.0077	0.0064
		std.dev.			0.009	0.0039	0.0035
	during	mean	2591	2491	0.336	0.0238	0.0175
		std. dev.			0.017	0.0212	0.0181

Table 4.2: Manipulation effects on copper prices, deliverable stocks and price volatilities

year	average		year	average	
	weekly	monthly		weekly	monthly
1981	0.130	0.013	1990	0.022	0.022
1982	0.014	0.013	1991	0.011	0.012
1983	0.013	0.012	1992	0.007	0.008
1984	0.011	0.009	1993	0.012	0.014
1985	0.014	0.013	1994	0.0136	0.014
1986	0.009	0.012	1995	0.013	0.014
1987	0.018	0.019	1981-1995	0.0146	0.015
1988	0.027	0.028	1991-1995	0.0114	0.012
1989	0.021	0.021			

Table 4.3: Copper cash price volatilities (January 1981- December 1995)

## 4.5 Manipulation and Risk Shifting

In the previous section, we have already examined the effects of manipulation on the price discovery function of a futures market, focusing on the relationships between the futures price and the future cash price. Now we turn to investigate the effects of manipulation on the risk-shifting function of a futures market, especially the basis and basis risk. Although it is commonly alleged that manipulation usually pushes a market from a normal market to an inverted market, and causes the basis to be more volatile, rare empirical studies have been done on this issue. Barnhart, Kahl and Barnhart (1996) studied manipulation effects on the July 1989 soybean futures contract in the CBOT market by looking distortions in futures price structures which are not explainable in terms of seasonality. The suggested methods and information used may not generally be applicable in examining the basis behaviour in the LME market.

### 4.5.1 Analysis of basis and basis risk

The basis is expected to change over the life of a hedge. For a storable commodity, the basis should reflect the storage costs over the period. Basis risk means unexpected changes in the basis, which affects the riskiness of hedging. It is obvious that basis risk is important for hedging and production decisions. Consider a simple example of a perfect hedge. Suppose a producer enters a short futures position at  $t = 1$  to hedge his production level at  $t = 2$ . Assume that the cash price and futures price are  $c_1$  and  $f_1$  at  $t = 1$ ,  $c_2$  and  $f_2$  at  $t = 2$  respectively. He will close out his futures position at  $t = 2$ . Therefore, the producer's profits are:  $(c_2 - c_1) + (f_1 - f_2)$ , i.e.,  $b_2 - b_1$ , where  $b_1$  and  $b_2$  are the basis at  $t = 1$  and  $t = 2$  respectively. Thus it is clear that changes in basis affect the producer's profits directly.

Some theoretical work has been undertaken on the impact of basis and basis risk on hedging, production, and investment decisions. Anderson and Danthine (1981) presented a theoretical analysis on this issue that included the existence of basis risk and the



availability of more than one hedging instrument. They showed that basis risk implies that the optimal hedging ratio is less than one. Without basis risk, an agent will hedge the entire cash position, while in the presence of basis risk, he/she will hedge only a portion of the cash position. Paroush and Wolf (1989) compared production behaviour in the presence of basis risk. They found that in the absence of basis risk, the production decision is unaffected by the distributions of cash prices and the attitude towards risk, and production is a function only of the cost parameters and the period 1 deterministic futures price. This occurs because the futures market completely eliminates price risk. When there exists basis risk, agents trade-off price risk with basis risk, and the optimal production decision depends on the level of risk aversion and the variance of the spot price. Paroush and Wolf also showed that production level and optimal hedge ratio in the presence of basis risk are both less than those in the absence of basis risk, and as the basis risk increases, production falls.

Various attempts have been also made to search the determinants of basis. At least part of the contemporaneous differences of futures price and cash price can be explained by the costs of storage between the time periods to which the prices refer. This is that, if the cash price refers to commodity traded now and the futures price is for a commodity traded three months later, the two prices should differ by the costs of storing the commodity for three months. It is termed the Cost of Carry model or the Carrying Charge theorem, which was first proposed by Working (1949), and then developed and empirically tested by Brennan (1958), Tester (1958), French (1986), Brennan (1991) and Bailey and Ng (1991), etc. Carrying charges are the total costs of carrying a commodity forward, including storage costs, insurance costs, transportation costs and financing costs. If the basis matches the carrying costs, we say the market is in full carry. But in practice, futures prices vary from full carry for many commodities. In general, the Cost of Carry model fails to apply when an asset has a convenience yield - a return on holding the physical assets. This convenience yield may arise because inventory can have productive value, for example, holding inventory may allow the agent to meet unexpected demand.

When holding an asset has a convenience yield, the futures price will be below full carry. In extreme cases, the market can be so far below full carry that the cash price can exceed the futures price, i.e., the market is in backwardation.

Another dominant theory to explain the basis and basis movements is the Supply of Storage theory (Kaldor 1939; Working 1949; Brennan 1958; Fama and French 1987, and Williams 1986). The Supply of Storage theory states that the price difference (basis) can be explained in part by supply and demand conditions applicable to each commodity. If there is a supply shock or some other incidents which may influence the supply and demand conditions, the basis will change accordingly.

Both theories have been considered to be important to explain basis and basis risk empirically. We attempt to apply these theories to test whether the basis and basis movements on the LME copper market are explainable by theories in periods of alleged manipulation. If we find the basis behaviour during the periods of manipulation is significantly different from what the models implied or different from that in other periods, then we may conclude manipulation has adverse effects on hedging through its effects on the basis and basis risk.

#### 4.5.2 The econometric models

Following Fama and French (1987), Brennan (1991) and Bailey and Ng (1991), in the Cost of Carry model, the basis is a function of interest forgone ( $R_t$ ), marginal storage costs ( $W_t$ ), and marginal convenience yield ( $CY_t$ ). Mathematically,

$$B_t = f(R_t, W_t, CY_t) \quad (4.3)$$

The contribution of interest foregone and storage costs to basis is negative, whereas the contribution of convenience yield to the basis is positive.

We propose to examine the three-month copper basis behaviour on the LME, and to

use 3-month Libor<sup>14</sup> as the risk free interest rate in study. LME warehousing costs are quoted as a fixed amount per metric tonne of the metal and adjusted every fiscal year. The common approach to calculating convenience yields is the formula (4.5) below. We first calculate 3-month futures yields excluding warehousing costs, and then calculate the associate convenience yields. The effect of storage costs on the basis is therefore captured by the adjusted convenience yields.

The annualised ex-cost 3-month yield ( $Y_t$ ) is:

$$Y_t = \left( \frac{F_{t,3month} - W_{t,3month}}{S_t} \right)^4 - 1 \quad (4.4)$$

The convenience yield is calculated by:

$$CY_t = e^{[\ln(1+R_t) - \ln(1+Y_t)]} - 1 \quad (4.5)$$

where  $F_{t,3month}$  is the 3-month futures price observed at time  $t$ ,  $S_t$  is the cash price at time  $t$ , and  $W_{t,3month}$  is the storage costs for storing cash commodities for 3 months at time  $t$ .

The relationship between convenience yield, interest rate, and commodity futures yield is that, the higher the interest rate, the lower is the commodity futures yield, and the higher is the convenience yield. We calculate the convenience yield for copper from January 1981 to September 1996, and it is graphed in Figure 4-6. However, this approach of measuring convenience yield may be inappropriate for our econometric analysis, since the explained variable and the convenience yield are based on the same information set. Proxies for storage costs and convenience yield are therefore used. Variables such as current stocks, expected production or expected demand could serve as proxies. Since current price may incorporate the effects of these variables, price is therefore used as a proxy for convenience yield. Following Brennan (1991), Bailey and Ng (1991) and Barnhart, Kahl and Barnhart (1996), we choose a lagged log futures price  $LN(F_{t-1})$  as a

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<sup>14</sup>The 3-month libor data are from Datastream.

proxy. The use of the lagged futures price, rather than current price may reduce possible manipulation effects. This is particularly the case on the LME, since the lagged futures price and the basis refer to different contracts.

In order to get rid of manipulation effects, we also employ a more intuitive method of measuring convenience yield based on Ward and Dasse (1977). Convenience yield ( $CYSC_t$ ) at time  $t$  is explained in terms of

$$CYSC_t = \begin{cases} \frac{1}{SC_t/\overline{SC}_t} & \text{if } 0 < SC_t/\overline{SC}_t \leq 1 \\ 0 & \text{if } SC_t/\overline{SC}_t > 1 \end{cases} \quad (4.6)$$

where  $SC_t$  is the deliverable stocks at time  $t$ , and  $\overline{SC}_t$  is the average level of deliverable stocks up to 2 months backward from time  $t$ .

This function form implies that the higher the marginal convenience yield, the lower is the level of stocks compared to normal (the previous 2-month average level), and zero for stocks above normal.

We add a dummy variable ( $D_1$ ) in each period where a manipulation was identified. Conforming to previous studies, we use the negative basis  $RB_t$  (log cash price - log futures price) instead of basis  $B_t$  in the empirical model. Durbin-Watson test shows that there is a serial autocorrelation, in the specification of the econometric model, a lagged explanatory variable ( $RB_{t-1}$ ) is therefore added. If the lagged futures price is used as a proxy for convenience yield, the econometric model of equation (4.3) can be rewritten as:

$$RB_t = \alpha_0 + \alpha_1 RB_{t-1} + \alpha_2 R_t + \alpha_3 LN(F_{t-1}) + \theta D_1 + \varepsilon_t \quad (4.7)$$

and if equation (4.6) is used to measure the convenience yield, then equation (4.3) becomes:

$$RB_t = \beta_0 + \beta_1 RB_{t-1} + \beta_2 R_t + \beta_3 CYSC_t + \theta D_1 + \eta_t \quad (4.8)$$

$$\text{where } D_1 = \begin{cases} 1 & \text{if manipulation is identified} \\ 0 & \text{otherwise} \end{cases}.$$

In the Supply of Storage theory, as suggested by Working (1949) and Williams (1986), the basis is a function of deliverable supply and deliverable supply squared.<sup>15</sup> Mathematically,

$$B_t = f[SC_t, (SC_t)^2] \quad (4.9)$$

We add a dummy variable ( $D_1$ ) to see whether manipulation contributes to the basis in addition to deliverable stocks which reflect market fundamental aspects. The variable - lagged basis is also included in the model. The empirical model of equation (4.9) can then be written:

$$B_t = \gamma_0 + \gamma_1 B_{t-1} + \gamma_2 SC_t + \gamma_3 (SC_t)^2 + \theta_1 D_1 + \delta_t \quad (4.10)$$

Because the variable of deliverable stocks is non-stationary (see Table 4.4 and Table 4.5), we use a market indicator at time  $t$  ( $MI_t$ ) as a proxy. The market indicator is calculated as deliverable stocks at time  $t$  over the average level two month (8 weeks) backward, i.e.,

$$MI_t = \frac{SC_t}{(\sum_{t-7}^t SC_t)/8} \quad (4.11)$$

If the market indicator is used, the econometric model of equation (4.9) then becomes:

$$B_t = \gamma_0 + \gamma_1 B_{t-1} + \gamma_2 MI_t + \gamma_3 (MI_t)^2 + \theta_1 D_1 + \epsilon_t \quad (4.12)$$

According to Cost of Carry theorem, in equation (4.7) and (4.8), the coefficients for interest rate are expected to be positive, reflecting the fact that the higher the opportunity costs of storage, the higher is the futures price exceeding the cash price, and the larger is the negative basis. While the coefficients for convenience yield are expected to be

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<sup>15</sup>The Supply of Storage theory actually argues that the relationship between the basis and deliverable supply is nonlinear. In the specification of the econometric model, one may add a cubic term (i.e., deliverable supply cubed). However, as suggested by Barnhart *et al.* (1996), the general results are similar regardless of whether a cubic term is included. Moreover, the coefficients of the cubic term in the estimation of this model are all not well-determined, we therefore exclude this term as well.

negative, suggesting that in the case of supply shortage, the difference of the futures price exceeding the cash price should diminish. In extreme supply shortage cases, negative basis may become zero, even negative. The coefficient for manipulation dummy should be negative, because manipulation raises cash price higher relative to forward price. But in equation (4.10) and (4.12), the coefficients for deliverable stocks are expected to be negative (i.e., the market is in backwardation), since the greater physical supply in the delivery market, the smaller is the basis. If manipulation influences the basis, the coefficient for manipulation dummy is expected to be positive, which implies that manipulation exacerbates the basis, even to the extent of pushing a normal market into an inverted market.

### 4.5.3 Data

The sample period is from July 1991 to September 1996. Data on deliverable stocks in LME warehouses is only available weekly or twice-weekly over the sample period. Hence we construct weekly copper and aluminium observations on basis  $B_t$  (log cash price less log futures price), negative basis  $RB_t$  (log futures price less log cash price), 3-month Libor, and deliverable stocks in million tones in LME warehouses. Aluminium data is used only as a comparison to see to what extent copper basis is departure from aluminium basis, because copper and aluminium may be seen as sharing similar consumption time paths and are the two most liquid LME contracts (Gilbert 1996). Since Dickey-Fuller tests show all variables in the study are stationary with the exception of SC and LSC, the deliverable stocks (in million tones) for copper and aluminium respectively, level equations are used. Summary statistics for all variables are reported in Table 4.4 and Table 4.5. See also Figures 4-3 - 4-6.

### 4.5.4 Results

We estimate equation (4.7), (4.8), (4.10), and (4.12) for copper and aluminium respectively over the whole sample and sub-samples from 1991 throughout September 1996.

	B	libor	CY	CYSC	SC	MI
mean	0.0835	0.0708	0.1377	0.0184	0.3249	1.004
std.dev.	0.0216	0.0282	0.1102	0.0320	0.1112	0.056
skewness	2.0462	0.6215	2.1688	2.8579	1.0329	-0.069
kurtosis	5.8633	-0.777	7.9664	11.217	0.6186	1.226
normality( $\chi^2$ )	261.4*	81.9*	203.64*	564.5*	102.8*	17.4*
stationarity	I(0)	I(0)	I(0)	I(0)	I(1)	I(0)
*denotes significant at 1%.						

Table 4.4: Summary statistics of variables for copper

	B	CYSC	SC	MI
mean	-0.0184	0.0154	1.3288	1.008
std.dev.	0.0048	0.0316	0.7186	0.038
skewness	2.0596	2.161	0.4044	-0.735
kurtosis	7.294	3.559	-1.072	0.5792
normality ( $\chi^2$ )	179.6*	887.9*	56.9*	31.4*
stationarity	I(0)	I(0)	I(1)	I(0)
*denotes significant at 1%.				

Table 4.5: Summary statistics of variables for aluminium

Estimation of these models for aluminium is performed for the purpose to see to what extent the results for aluminium differ from those for copper.

The results of estimating equation (4.7) for copper are given in Table 4.6. The estimated coefficients for the lagged futures price and Libor except for the sub-sample (1995 to September 1996) are well-determined, and the signs are as expected. The signs for the manipulation dummy are correct and the coefficients are well-determined. The negative coefficient for manipulation dummy suggests that manipulation has positive effects on the basis (recall that  $RB_t$  represents negative basis).

Estimation results of equation (4.8) for copper are given in Table 4.8. The coefficients for convenience yields and the manipulation dummy are well-determined, and the signs are as expected. But coefficients for Libor are less well-determined for the sub-sample (1991 to 1992) and the sub-sample (1995 to September 1996), and the sign for sub-sample (1993 to 1994) is not as expected, which may be due to acute backwardations at that time, and convenience yields and manipulation dummy may dominate this relationship.

period	constant	$RB_{t-1}$	libor	$LNF_{t-1}$	$D_1$	$R^2$	sample size
1991-1992	0.043 (0.32)	0.601 (8.52)	0.017 (2.08)	-0.052 (-0.28)	-0.098 (-4.37)	0.71	103
1993-1994	0.1065 (3.41)	0.610 (9.56)	0.282 (0.61)	-0.014 (-3.16)	-0.014 (-5.58)	0.82	104
1995-Sept. 96	-0.042 (-1.42)	0.562 (6.59)	0.224 (0.32)	0.003 (0.18)	-0.017 (-3.28)	0.61	92
1990 Sept. 96	0.123 (3.58)	0.695 (18.7)	0.078 (2.73)	-0.017 (-3.69)	-0.011 (-5.82)	0.75	299
Note: values in parentheses are t-values							

Table 4.6: Estimation results of equation (4.7) for copper

period	constant	$RB_{t-1}$	libor	$LNF_{t-1}$	$D_1$	$R^2$	sample size
1991-1992	-0.004 (-0.23)	0.879 (14.4)	0.037 (0.32)	0.001 (0.52)	0.000 (0.75)	0.79	103
1993-1994	0.025 (2.09)	0.745 (10.2)	0.011 (0.65)	-0.003 (-1.79)	0.000 (0.25)	0.70	104
1995-Sept. 96	0.042 (0.81)	0.732 (9.75)	0.135 (0.83)	-0.004 (-1.08)	0.000 (0.23)	0.61	92
1990 Sept. 96	0.018 (2.46)	0.767 (19.8)	0.009 (1.45)	-0.002 (-2.08)	0.000 (1.01)	0.69	299
Note: values in parentheses are t-values							

Table 4.7: Estimation of equation (4.7) for aluminum

The coefficients for manipulation dummy are larger than those in equation (4.7), which may suggest the measurement of convenience yields in equation (4.8) is better than that in equation (4.7).

We also estimate equation (4.7) and (4.8) for aluminium, and the results are reported in Table 4.7 and Table 4.9. The coefficients for Libor are not well-determined in either equations, but all coefficients for the convenience yield except for the sub-sample (1995-September 1996) in equation (4.7) are well-determined and the signs are correct. It is interesting to note that, the coefficients for the manipulation dummy are extremely small (close to zero) and none of the coefficients are significant even at 10% significance level. This may offer reassurance of the fact that manipulation influences the copper basis changes.



period	constant	$RB_{t-1}$	libor	CYSC	$D_1$	$R^2$	sample size
1991-1992	0.002 (0.32)	0.598 (8.64)	0.003 (0.05)	-0.046 (-1.72)	-0.011 (-4.48)	0.70	103
1993-1994	0.008 (3.62)	0.707 (12.9)	-0.112 (-2.86)	-0.035 (-1.94)	-0.013 (-5.06)	0.81	104
1995-Sept. 96	-0.029 (-0.89)	0.533 (6.32)	0.424 (0.75)	-0.074 (-1.93)	-0.019 (-3.93)	0.63	92
1990 Sept. 96	-0.002 (-0.82)	0.732 (20.1)	0.004 (1.46)	-0.064 (-3.07)	-0.012 (-5.98)	0.75	299
Note: values in parentheses are t-values							

Table 4.8: Estimation results of equation (4.8) for copper

period	constant	$RB_{t-1}$	libor	CYLSC	$D_1$	$R^2$	sample size
1991-1992	0.003 (1.97)	0.862 (16.9)	0.001 (0.01)	-0.010 (-1.82)	-0.003 (-0.24)	0.78	103
1993-1994	0.006 (3.61)	0.638 (7.91)	0.021 (1.24)	-0.044 (-3.17)	0.0002 (0.31)	0.71	104
1995-Sept. 96	0.058 (0.58)	0.644 (8.15)	0.033 (0.18)	-0.039 (-2.51)	-0.000 (-0.83)	0.65	92
1990 Sept. 96	0.005 (6.34)	0.699 (17.1)	0.011 (1.74)	-0.029 (-4.59)	-0.002 (-1.12)	0.76	299
Note: values in parentheses are t-values							

Table 4.9: Estimation results of equation (4.8) for aluminium

period	constant	$B_{t-1}$	SC	$(SC)^2$	$D_1$	$R^2$	sample size
1991-1992	-0.059 (-1.77)	0.546 (7.60)	0.466 (1.88)	-0.936 (-1.98)	0.011 (4.74)	0.72	103
1993-1994	0.005 (0.44)	0.687 (11.9)	-0.026 (-0.48)	0.004 (-0.08)	0.012 (4.71)	0.81	104
1995-Sept. 96	0.011 (0.45)	0.535 (6.43)	0.036 (0.14)	-0.186 (-0.37)	0.020 (3.99)	0.63	92
1990-Sept. 96	0.015 (2.49)	0.709 (19.2)	-0.067 (-2.05)	0.062 (1.79)	0.009 (4.99)	0.75	299
Note: values in parentheses are t-values							

Table 4.10: Estimation results of equation (4.10) for copper

In examining manipulation effects on the basis using the Supply of Storage model, we estimate both equations (4.10) and (4.12). The estimation results for copper are given in Table 4.10 and 4.11 respectively. The signs of coefficients for all variables except those for SC in the sub-samples (1991 to 1992) and (1995 - September 1996) are as expected. The “wrong signs” for those sub-samples might be that the effects of manipulation on deliverable stocks are not well captured by the manipulation dummy. The significant positive values of the coefficients for manipulation dummy imply that manipulation has positive effects on the basis. However, all the coefficients of the non-manipulation dummy in both equations are negative except for the sub-sample (1990 - 1992), and are not statistically significant. We estimate both equations for aluminium during the same periods. Although signs for manipulation dummy are almost positive as well (but negative in equation (4.10) for sub-sample (1993 - 1994) and sub-sample (1995 - 1996)), they are very small and not statistically significant. The results are reported in Table 4.12 and 4.13. The statistically significant coefficients of the manipulation dummy in equations (4.10) and (4.12) for copper, but not for aluminium, suggest that copper manipulation has indeed influenced the copper basis behaviour.

In searching manipulation effects on the basis and basis risk, we also calculate the basis, basis volatilities, the correlation coefficients between cash prices and futures prices, and the correlation coefficients between the basis and deliverable stocks for all identified

period	constant	$B_{t-1}$	MI	$(MI)^2$	$D_1$	$R^2$	sample size
1991-1992	-0.432 (-1.59)	0.687 (8.72)	-0.339 (-4.10)	0.136 (3.73)	0.010 (4.24)	0.81	103
1993-1994	-0.343 (-1.94)	0.754 (14.4)	-0.639 (-2.11)	0.376 (2.08)	0.012 (4.83)	0.81	104
1995-Sept. 96	0.342 (1.56)	0.534 (6.01)	-0.648 (-1.56)	0.311 (1.40)	0.022 (3.75)	0.63	92
1990-Sept. 96	0.156 (2.22)	0.739 (19.4)	-0.278 (-1.84)	0.121 (1.86)	0.011 (5.78)	0.75	299
Note: values in parentheses are t-values							

Table 4.11: Estimation results of equation (4.12) for copper

period	constant	$B_{t-1}$	LSC	$(LSC)^2$	$D_1$	$R^2$	sample size
1991-1992	-0.005 (-3.39)	0.791 (12.8)	-0.001 (-2.61)	0.006 (1.61)	0.000 (0.48)	0.81	103
1993-1994	-0.019 (-1.88)	0.806 (14.2)	0.016 (1.61)	-0.004 (-1.58)	-0.000 (-0.72)	0.70	104
1995-Sept. 96	-0.003 (-0.62)	0.768 (10.9)	-0.002 (-1.34)	0.001 (0.211)	-0.001 (-0.61)	0.60	92
1991-Sept. 96	-0.002 (-1.87)	0.835 (30.4)	-0.008 (-1.78)	0.001 (1.76)	0.001 (0.71)	0.76	299
Note: values in parentheses are t-values							

Table 4.12: Estimation results of equation (4.10) for aluminium

period	constant	$B_{t-1}$	MI	$(MI)^2$	$D_1$	$R^2$	sample size
1991-1992	-0.076 (-1.97)	0.732 (10.4)	0.163 (0.91)	-0.081 (-1.98)	0.001 (1.01)	0.81	103
1993-1994	0.413 (1.23)	0.678 (8.73)	-0.817 (-1.56)	0.398 (1.16)	0.000 (0.027)	0.71	104
1995-Sept. 96	0.239 (0.905)	0.654 (8.28)	-0.465 (-0.86)	0.219 (0.79)	0.000 (0.82)	0.64	92
1990-Sept. 96	0.076 (1.00)	0.704 (17.8)	-0.138 (-1.68)	0.056 (1.73)	0.001 (0.36)	0.74	299
Note: values in parentheses are t-values							

Table 4.13: Estimation results of equation (4.12) for aluminium

manipulation periods from 1991 to 1996. The middle two are commonly considered as a measure of basis risk, and the last one is regarded as negative in normal case in terms of the Supply of Storage model. The results confirm to the discussions in section 4.3. The results for copper are reported in Table 4.14 and for aluminium in Table 4.15. The period length prior to manipulation is tailored to be the same as that of manipulation. We find that the average weekly basis for copper increased by 194%, 576%, 126% and 412% respectively for 4 identified manipulations from 1991 to 1996. The average weekly basis volatilities increased by 242%, 175%, 125% and 239% respectively; however, the correlation coefficients between cash and futures prices decreased uniquely, although to variant extent. One interesting aspect is that most of the correlation coefficients between the basis and deliverable stocks for copper change from negative to positive values due to manipulation which are not explainable in terms of standard economic theory. This once again suggests that manipulation causes the basis movements departure from normal. But we do not find the similar patterns for aluminium.

## 4.6 Manipulation and the LME Copper Price

The previous sections examined the effects of the alleged Sumitomo manipulation on the LME relative price relationships, i.e., the futures forecast errors and the basis. We found that the manipulation not only produced systematically positive forecast errors, but also exacerbated the basis and basis risk on the LME. This may undermine the functioning of the LME copper market. In this section, we proceed to look at whether the manipulation also affected the absolute copper price level on the LME. This point was raised by the CFTC Order in May 1998, but without providing evidence. It is of our interests since the LME is the major world futures market for non-ferrous metals, and forms the pricing basis for physical copper trading throughout the world. The influence of the manipulation on the LME price has important implications on the worldwide copper production, consumption and investment decisions. This section therefore investigates

Date	manipulation	item	basis	volatility of basis	corr.coeff. B/W cash /futures	corr.coeff. B/W basis /stocks
Aug. 2 to Dec. 6, 1991	before  in	mean	-0.016	0.004	0.969  0.944	-0.544  0.291
		std.dev.	0.0048	0.003		
		mean	0.0145	0.005		
		std.dev.	0.0133	0.005		
Aug. 11 to Sept.16 1993	before  in	mean	0.0030	0.002	0.974  0.935	-0.613  0.619
		std.dev.	0.0045	0.001		
		mean	0.0203	0.003		
		std.dev.	0.0045	0.001		
Oct. 10 1995 to Jan. 19, 1996	before  in	mean	0.0249	0.005	0.935  0.970	-0.881  -0.130
		std.dev.	0.0158	0.003		
		mean	0.0563	0.012		
		std.dev.	0.0259	0.009		
April 11 to June 14 1996	before  in	mean	0.0093	0.005	0.928  0.792	0.084  0.432
		std.dev.	0.0051	0.001		
		mean	0.0476	0.016		
		std.dev.	0.0371	0.012		

Table 4.14: The effects of manipulation on the basis and basis risk (July 1991- September 1996)

Date	manipulation	item	basis	valatility of basis	corr. coeff. B/W C/F	corr. coeff. B/W B/SC
Aug.2 to Dec. 6 1991	before	mean	-0.023	0.009	0.997	-0.733
		std.dev.	0.0019	0.004		
	in	mean	-0.024	0.001	0.998	0.434
		std.dev.	0.001	0.001		
Aug. 11 to Sept.16 1993	before	mean	-0.018	0.005	0.998	-0.028
		std.dev.	0.0006	0.001		
	in	mean	-0.018	0.001	0.998	0.758
		std.dev.	0.0009	0.001		
Oct.10 to Jan. 19 1996	before	mean	-0.013	0.001	0.996	0.758
		std.dev.	0.004	0.001		
	in	mean	-0.017	0.026	0.956	0.523
		std.dev.	0.008	0.004		
Apr. 11 to June 14 1996	before	mean	-0.018	0.003	0.996	-0.662
		std.dev.	0.003	0.004		
	in	mean	-0.021	0.013	0.994	-0.301
		std.dev.	0.002	0.001		

Table 4.15: The basis and basis risk for aluminium (July 1991 - September 1996)

date	manipulation	cash price		futures price	
		mean	std. dev.	mean	std. dev.
Aug. 2 to Dec.6, 1991	in	2320	66	2286	39
	after	2198	44	2207	38
Aug. 11 to Sept.16, 1993	in	1956	42	1917	34
	after	1706	25	1723	24
Oct. 13 to Jan. 19, 1996	in	2855	135	2690	99
	after	2571	72	2553	47
Apr. 11 to June 14, 1996	in	2591	176	2484	198
	after	1933	65	1917	48

Table 4.16: Copper price behaviour in the presence of manipulation

the effects of the Sumitomo manipulation on the LME copper cash price.

### 4.6.1 Methodology

In order to explore the effects of the manipulation on the copper price level, first of all, we need to determine what would have been the copper price. In practice, there may be several ways to attempt to determine such a price in the absence of manipulation. Based on standard microeconomic theory, for instance, one can compute an equilibrium price by modelling the fundamentals of supply and demand. Alternatively, one can look at the data directly and estimate the average price level for the relevant period. We choose to use the latter approach. We therefore estimate a reduced form VAR for relevant variables, then forecast ahead out of sample using the estimated VAR parameters, and finally compare the forecast prices with the actual LME cash prices. The forecast period (from the second half of 1994 to June 1996) is chosen since during this period the manipulation was most seriously alleged, and Sumitomo has offered to settle allegations for this period with the CFTC and other civil lawsuits.

### 4.6.2 Data

We consider four variables: LME cash copper price, LME copper deliverable stocks, world refined copper consumption, and OECD industrial production. Industrial production provides a measure of industrial activity, which may be seen as driving the demand for the refined copper.

The data set used for the estimation consists of quarterly observations for world refined copper consumption, quarterly observations for OECD industrial production and the LME copper settlement price over the period of the first quarter of 1954 - the fourth quarter of 1997, and quarterly observations of LME copper deliverable stocks over the period of the fourth quarter of 1969 - the fourth quarter of 1997. The data for refined copper consumption, LME deliverable stocks and cash prices are taken from the “World Metal Statistics” published by the World Bureau of Metal Statistics. Data for OECD

	LRP	LSS	LOEIP
Mean	7.806	0.121	4.540
Std. dev.	0.317	0.097	0.094
Skewness	0.698	1.489	-0.032
Excess Kurtosis	0.392	1.404	-0.312
Minimum	7.298	0.007	4.324
Maximum	8.744	0.399	4.770
Normality ( $\chi^2$ )	10.9**	108.7**	0.113
** denotes 1% significance level			

Table 4.17: Summary Statistics (1969 - 1997)

industrial production are from OECD “Indicators of Industrial Activity”.

The LME copper price is deflated by the quarterly average of US producer price index (data source: IMF, International Financial Statistics), and this gives rise to the real LME copper price. By taking the log form of the real copper price and OECD industrial production, we obtain the log real LME copper price (LRP) and log OECD industrial production (LOEIP). Dividing log LME copper stocks by log world refined copper consumption, we obtain the copper stocks/consumption ratio (LSS),<sup>16</sup> where the world refined copper consumption is adjusted by using the fitted values from linear trend estimation over the period of the first quarter of 1954 - the fourth quarter of 1997. We therefore have three variables: LRP, LOEIP and LSS. The summary statistics for these three variables over the period of the fourth quarter of 1969 - the fourth quarter of 1997 are reported in Table 4.17.

### 4.6.3 Estimation

The methodology is based on the following simple VAR system,

$$A(L)X_t = \varepsilon_t \quad (4.13)$$

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<sup>16</sup>The copper stocks/consumption ratio is used to make the stock time series approximately stationary.



where  $A(L) = 1 - \sum_{i=1}^p A_i L^i$ ,  $E(\varepsilon_t) = 0$ ,  $E(\varepsilon_t \varepsilon'_s) = 0$  for  $t \neq s$ ,  $E(\varepsilon_t \varepsilon'_t) = \Sigma$ ,  $E(X_t \varepsilon'_t) = 0$ . This is a standard VAR representation in which  $X_t$  is a  $(1 \times n)$  vector of variables,  $A$  is an  $(n \times n)$  matrix of coefficients,  $L$  denotes the lag operator and  $\varepsilon_t$  is an  $(n \times 1)$  vector of white noises.

In our context,  $X_t$  in equation (4.13) includes three variables  $X_t = (LRP_t, LSS_t, LOEIP_t)'$ , and  $A$  becomes an  $(3 \times 3)$  matrix of coefficients.

We additionally impose two restrictions on the system:  $A_{31}(L) = 0$  and  $A_{32}(L) = 0$ . These imply that the LME price and stock/consumption ratio have no impact on the OECD industrial production level, but not the other way round. This reflects the fact that copper is relatively unimportant in the world economy. We start from a lag length of  $p = 8$ , and using the likelihood ratio tests, F-tests, the Schwarz and Hannan-Quinn information criterion to evaluate the model. The procedure yields lag lengths of 5 quarters for each of the three variables. The estimated results using the observations up to the second quarter of 1994 are reported in Table 4.18. The statistics of the model are recorded in Table 4.19.

We then proceed to use the estimated VAR parameters to undertake forecast of the LME cash price for 8 quarters ahead until the second quarter of 1996. In order to get a better measure of the price effects of the manipulation, in this forecast we condition the price forecast on actual industrial production, since Sumitomo was not likely to influence the level of OECD industrial production. The actual LME cash prices, forecast prices and forecast errors over this period are recorded in Table 4.20. In Table 4.20, the forecast variable is LRP, the variable of interest is the forecast price which is inflated by the US producer index, and so that it corresponds to the actual LME cash price. The residual is the difference between the actual price and the forecast price. As one can see from Table 4.20, the actual LME prices during the period from the third quarter of 1994 to the end of 1995 were above the forecast prices, and some times the actual price was 10% more than the forecast price. This may suggest that the manipulation increased the LME price, but not substantially. The negative residuals in the first two quarters of 1996 may

Explanatory variable	LRP	LSS	LOEIP
LRP	0.0000	0.0000	0.0000
LRP <sub>-1</sub>	0.8394 (0.122)	0.0424 (0.023)	0.0000
LRP <sub>-2</sub>	-0.1022 (0.160)	-0.0264 (0.031)	0.0000
LRP <sub>-3</sub>	0.0841 (0.162)	0.0160 (0.031)	0.0000
LRP <sub>-4</sub>	0.0006 (0.163)	-0.0371 (0.031)	0.0000
LRP <sub>-5</sub>	0.0096 (0.117)	0.0266 (0.023)	0.0000
LSS	0.0000	0.0000	0.0000
LSS <sub>-1</sub>	-1.1378 (0.605)	1.4754 (0.116)	0.0000
LSS <sub>-2</sub>	1.0174 (1.063)	-0.4256 (0.204)	0.0000
LSS <sub>-3</sub>	0.6342 (1.074)	-0.0167 (0.206)	0.0000
LSS <sub>-4</sub>	-0.7751 (1.065)	-0.1749 (0.204)	0.0000
LSS <sub>-5</sub>	0.1556 (0.626)	0.0804 (0.120)	0.0000
LOEIP	1.4501 (0.496)	0.0760 (0.095)	0.0000
LOEIP <sub>-1</sub>	-0.3072 (0.632)	-0.1946 (0.125)	0.8921 (0.099)
LOEIP <sub>-2</sub>	-0.5511 (0.726)	0.1946 (0.126)	0.0356 (0.128)
LOEIP <sub>-3</sub>	0.0438 (0.658)	-0.1636 (0.127)	-0.1322 (0.128)
LOEIP <sub>-4</sub>	-0.0741 (0.670)	0.0775 (0.128)	0.1346 (0.179)
LOEIP <sub>-5</sub>	-0.6485 (0.519)	0.1507 (0.099)	-0.0754 (0.086)
Constant	1.0069 (1.072)	-0.1680 (0.206)	0.6859 (0.698)
Trend	-0.7672 (0.001)	0.0167 (0.000)	0.1615 (0.003)
Seasonal <sub>1</sub>	0.0993 (0.089)	0.0125 (0.017)	-0.0670 (0.086)
Seasonal <sub>2</sub>	0.0356 (0.055)	-0.0000 (0.011)	-0.0412 (0.043)
Seasonal <sub>3</sub>	0.0876 (0.091)	0.0411 (0.018)	-0.0849 (0.093)
$\sigma$	0.1109	0.0212	0.0273
DW	2.00	2.03	1.98
standard errors are in parentheses			

Table 4.18: VAR parameter estimates

	LRP	LSS
ARCH test 4 lags, Chi Square (4)	7.59 (0.14)	6.81 (0.15)
Portmanteau test 10 lags	4.06	6.95
Error autocorrelation lags 1-5, Chi Square	4.25 (0.52)	14.5 (0.15)
Heteroscedastic error, Chi Square (32)	38.4 (0.21)	36.7 (0.26)

Table 4.19: Statistics of the model

period	actual price	forecast price	LRP	residual	
				\$	%
1994-3	2456	2296	7.6995	161.2	6.79%
1994-4	2779	2381	7.7322	397.4	15.44%
1995-1	2937	2604	7.8047	332.7	12.02%
1995-2	2891	2598	7.7900	293.0	10.69%
1995-3	3009	2867	7.8871	141.7	4.82%
1995-4	2906	2696	7.8236	209.3	7.48%
1996-1	2572	2677	7.8092	-105.6	-4.03%
1996-2	2476	2638	7.7824	-161.9	-6.34%

Table 4.20: The actual LME prices, forecast prices and forecast errors

arise from the declining of LME prices at that time, since the manipulation became more exposed, and this probed investigations by the CFTC, SIB and the LME itself.

In order to evaluate the robustness of the forecast of the LME cash price, we perform a simple Monte Carlo simulation experiment. We add an additive error to both the price and stock/consumption equations. The error term is assumed to be normally distributed with zero mean and standard deviation equal to the standard error of the specific estimated equation, and the two error terms are assumed to be a (correlated) joint normal distribution. Table 4.21 records the results of Monte Carlo simulations.<sup>17</sup> The results from the simulation suggest that the alleged Sumitomo manipulation may increase the LME cash price level by 5-15% during the period from the third quarter of 1994 to the end of 1995, and therefore confirm our previous results.

However, from Table 4.21 it is clear that the actual LME prices over the period of alleged manipulation were not significantly different from the mean simulated prices at 5% significance level. This implies that the price effects alone may be inconclusive about a manipulation, and “artificial” price therefore may only offer weak evidence in establishing a manipulation case. Indeed, in the real world not all manipulations are intended to raise absolute price level (for a discussion, see Section 4.4.3).

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<sup>17</sup>The number of simulations is 2411.

period	mean simulated price	residual		standard error	
		\$	%	\$	%
1994-3	2314	141.9	6.57%	258.9	11.18%
1994-4	2412	360.8	15.15%	382.7	15.81%
1995-1	2645	291.9	11.87%	445.6	16.76%
1995-2	2627	263.1	11.05%	461.5	17.35%
1995-3	2909	99.9	4.99%	526.3	17.97%
1995-4	2730	175.7	7.91%	501.7	18.32%
1996-1	2715	-143.3	-3.68%	510.3	18.65%
1996-2	2665	-190.4	-5.68%	499.5	18.58%

Table 4.21: Results of Monte Carlo simulations

## 4.7 Conclusions

Futures markets have been vigorously developed due to their two social benefits to economy, “price discovery” and “risk shifting”. We focus on these two basic functions of futures markets and look at whether futures manipulation interferes the functioning of futures markets. We found that the alleged Sumitomo manipulation had adverse effects on both the “price discovery” and the “risk shifting” functions of the LME copper futures market.

This study has tested the simple models set up in the previous chapters to show how manipulation affects the relationships between futures price and the future cash price. We used the LME daily copper price data from January 1991 to September 1996 to test our hypothesis, and found that the results conform with what our models implied. Our main findings are that, the effects of long manipulation on “price discovery” are typically that manipulation pushes futures prices above the future cash prices systematically, i.e., producing positive futures price forecast errors. Manipulation also affects cash price volatilities and patterns of commodity flows to delivery markets. Under this circumstance, the futures price becomes a biased estimate of the future cash price, and may mislead producers, hedgers or investors into making unwise decisions.

This research also employed two standard basis theories - the Cost of Carry model and the Supply of Storage model which have both been considered to have empirical relevance

by previous researchers in examining the contemporaneous relationships between futures price and cash price - the basis and basis risk, to investigate the effects of manipulation on the basis and basis risk using weekly LME data. We found that manipulation may be an important factor in affecting the basis and basis movements in addition to factors that have been noticed by previous researchers. We found that, typically, the effect of long manipulation on the basis is that manipulation strengthens the basis - raises the cash price relatively higher than the futures price. Manipulation also makes the basis more volatile. This may be caused by the uncertainty in manipulation probability and manipulated price.

The price effects of manipulation are to push futures price relatively higher than the future cash price, while the basis effects of manipulation are to raise cash price higher than futures price during the manipulation or alleged manipulation, in line of reasoning, as noticed by many observers, cash prices are expected to collapse immediately after manipulation. Copper price behaviour on the LME conformed to this fall of the cash prices. As shown in Table 4.16, comparing daily average prices during manipulation with those immediately after manipulation for two months, we found that cash price after each period of manipulation was lower than that during manipulation, and sometimes the fall was very large. The largest one was April-June 1996 manipulation where the average price was depressed by nearly 23%.

Finally, we examined the effects of the alleged Sumitomo manipulation on the LME cash price by using a simple VAR approach, and found that the actual LME cash prices over the period of the third quarter of 1994 - the fourth quarter of 1995 were generally above the forecast price. This may suggest that the manipulation has raised the LME cash prices over the period, but not substantially. We also performed simple Monte Carlo simulations, and the results from the simulations confirmed this price impact. However, the actual LME prices were not significantly different from the mean simulated prices at 5% significance level.

It is important to understand and measure manipulation effects in order to define

and identify manipulation which have debated for more than a century. The economic effects of manipulation have important policy implications for futures market regulators. However, this research does not answer all questions regarding to the effects of manipulation, for example, how, and to what extent manipulation affects different market users, how futures manipulation affects the pricing and basis behaviour of the OTC markets and options markets, whether manipulation in one market affects the pricing process and price volatilities of the other markets where the same commodity is traded, etc. To answer these questions, which is important in understanding and measuring the real costs of manipulation, is an issue of future research.

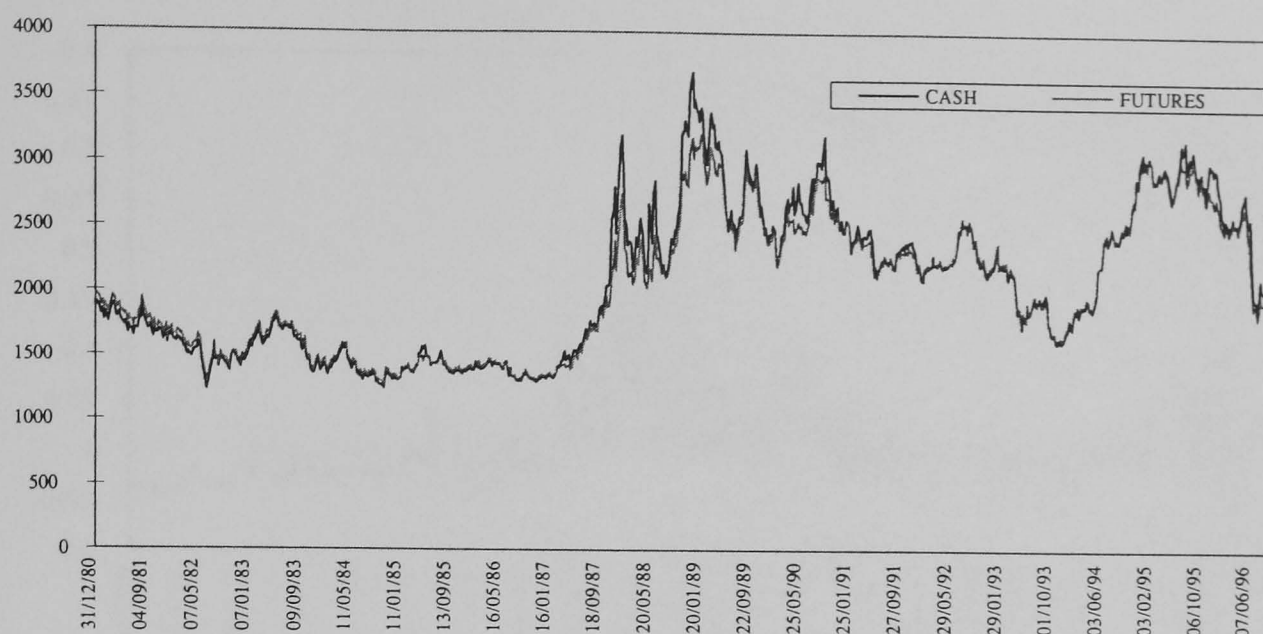


Figure 4-1: Copper Cash and 3-month Futures Prices (January 1981 - September 1996)

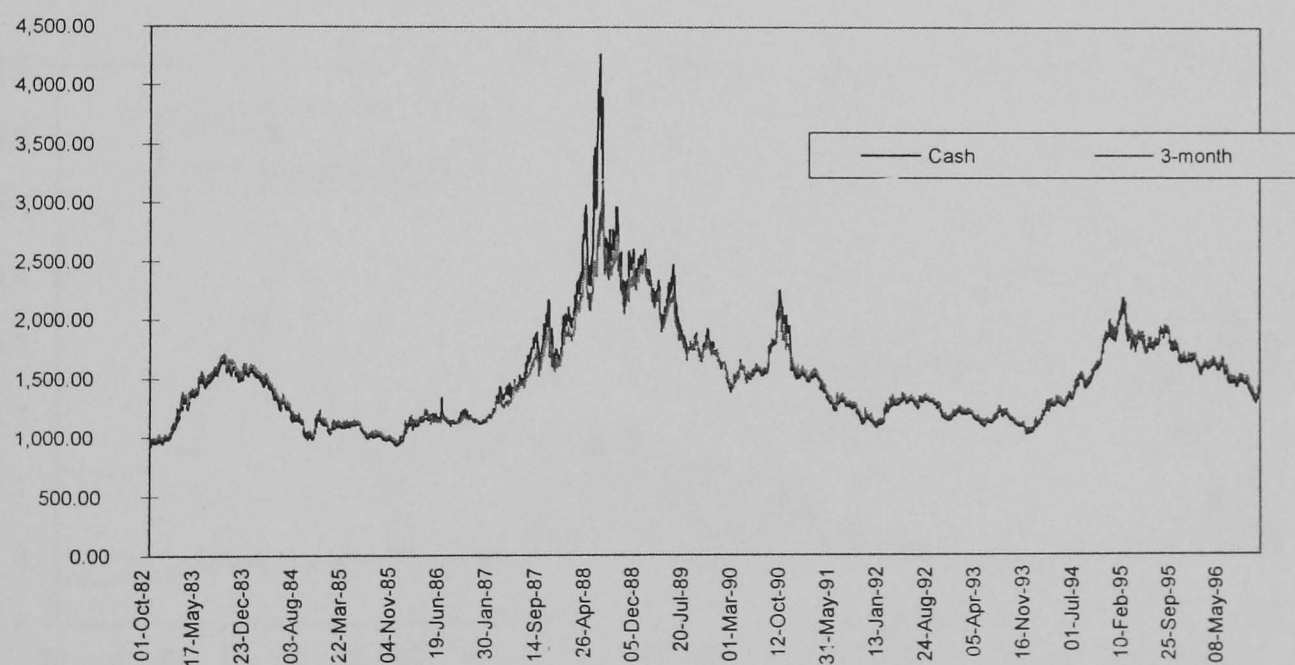


Figure 4-2: Aluminium Cash and 3-month Futures Prices (October 1982 - September 1996)

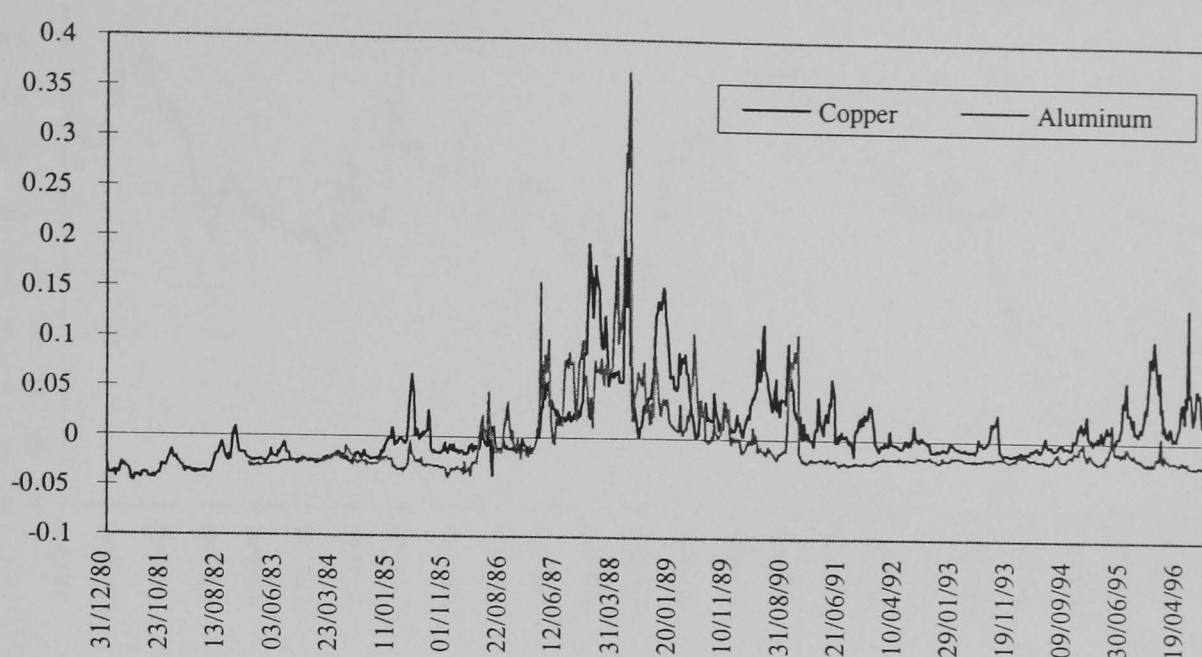


Figure 4-3: Copper and Aluminium Basis (January 1981- September 1996)

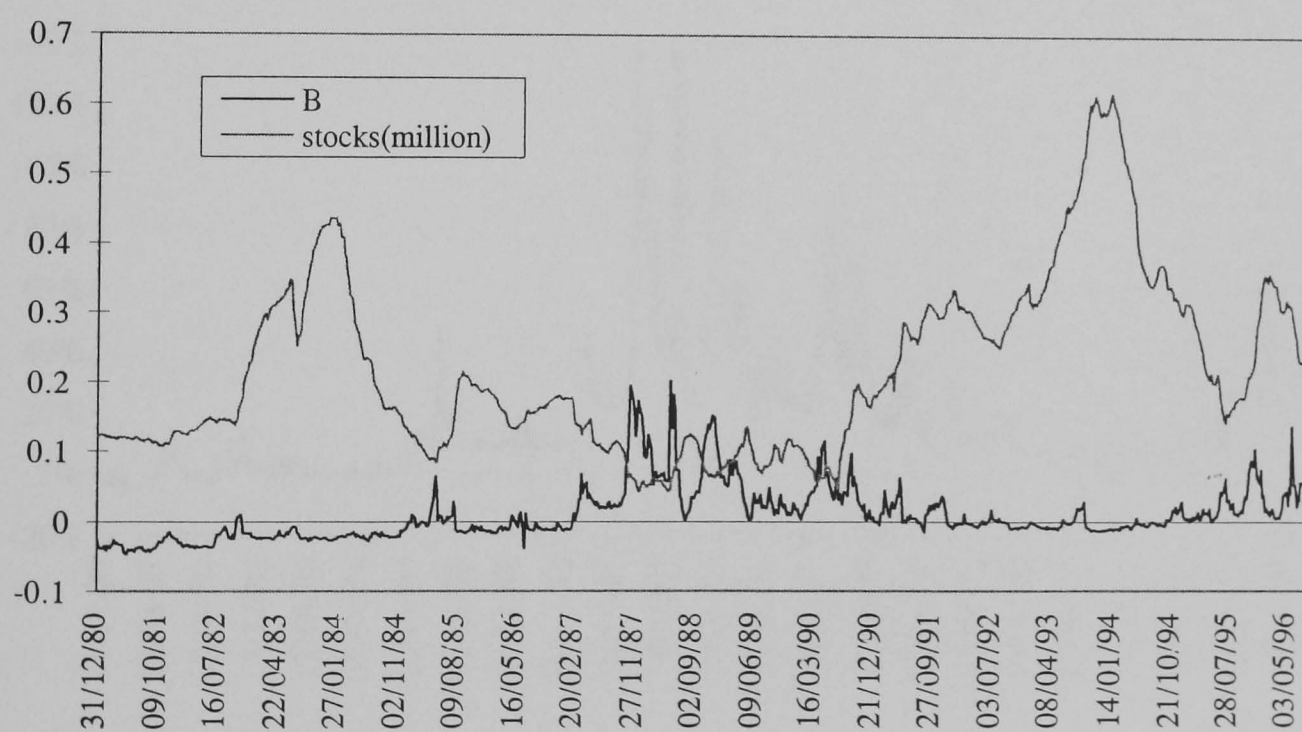


Figure 4-4: Copper Basis and Deliverable Stocks (January 1981 - September 1996)



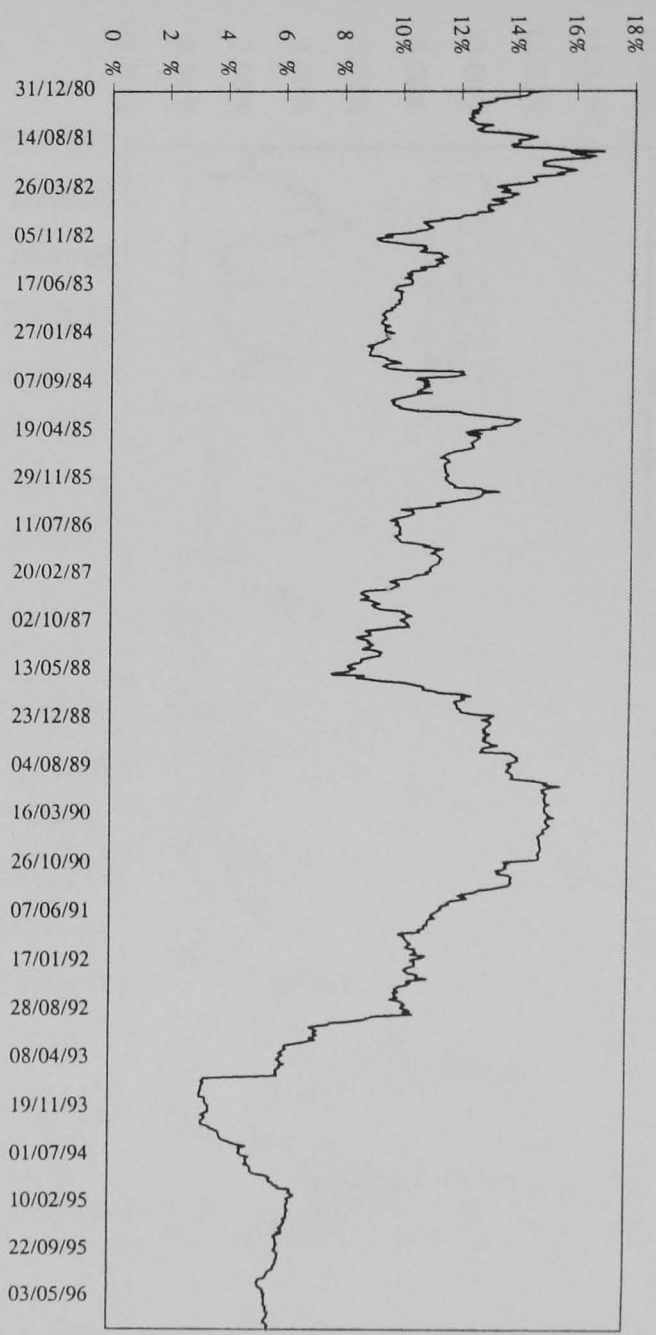


Figure 4-5: 3-month Libor (January 1981- September 1996)

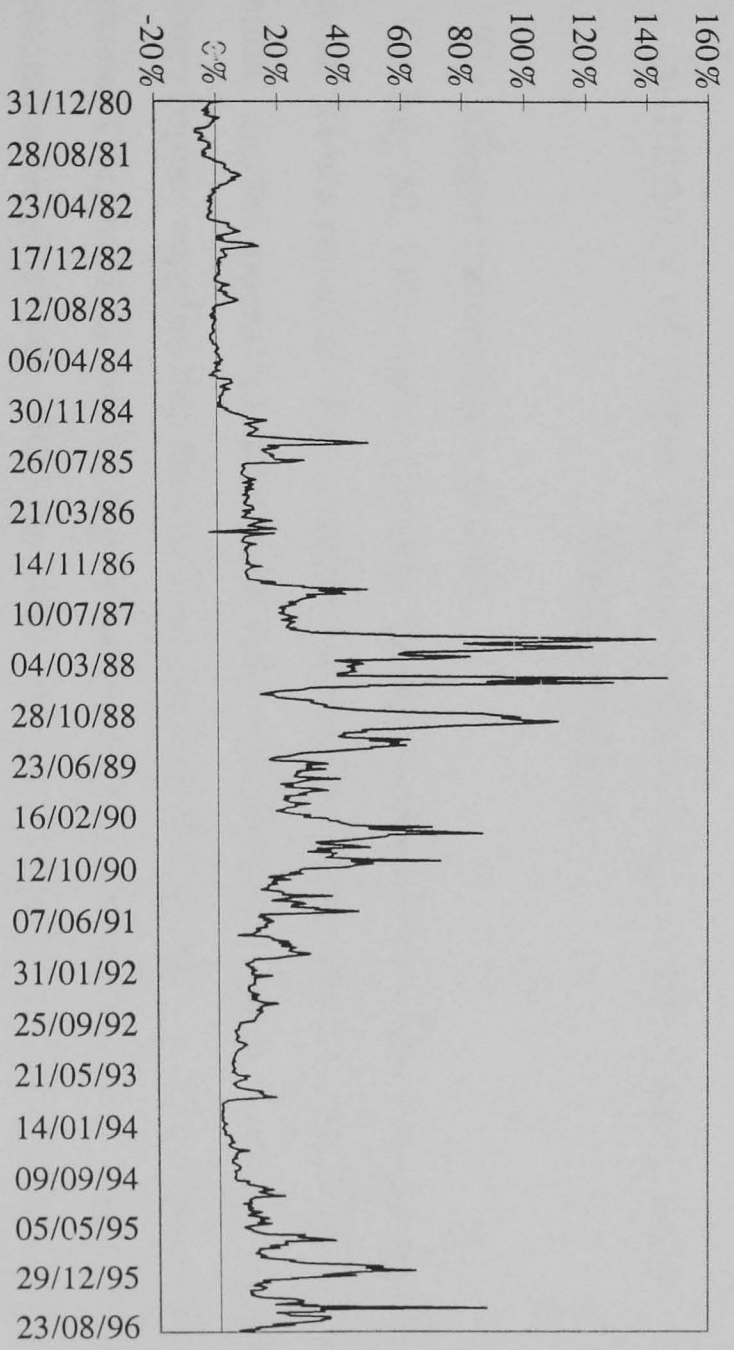


Figure 4-6: Copper Convenience Yields (January 1981-September 1996)

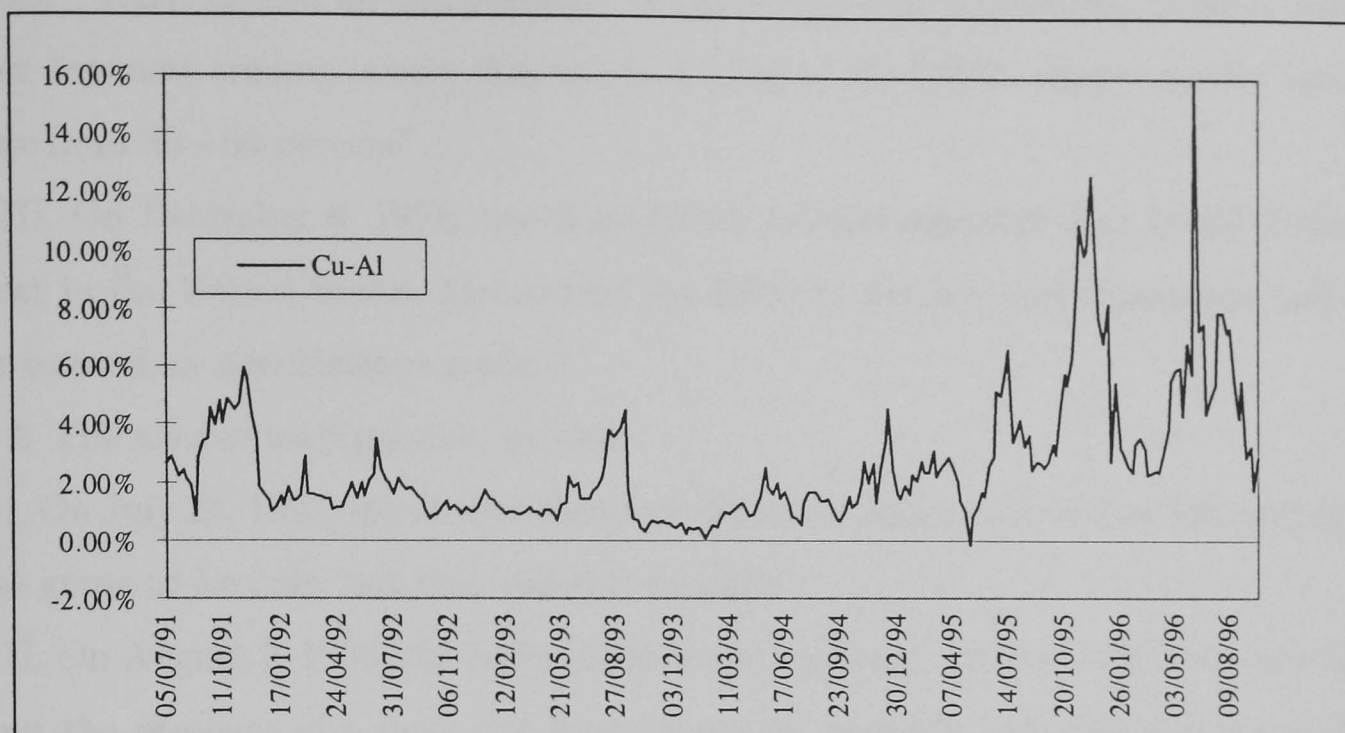


Figure 4-7: Differential Backwardations, Copper Basis less Aluminium Basis (July 1991 - September 1996)

## Appendix A:

### Summary of News Reports Relating to the Sumitomo Manipulation

#### 1. The alleged manipulation in 1991

I. On July 30, 1991, under the title "Market operators squeezing copper price", the *Financial Times* reported that a report released by the Banque Indosuez Group that, Influential market operators have been able to maintain a squeeze on London Metal Exchange copper supplies and thus to keep price artificially high, ... the Japanese Group (Sumitomo Corporation) has been purchasing substantial quantities of copper to meet its customers requirements, although some traders would argue that it (Sumitomo) was manipulating the market.

II. On December 4, 1991, the *Financial Times* reported that a "squeeze" griping the market was believed to have been caused by Sumitomo's taking of the LME copper

stocks: “What caused all this turmoil? Traders says that Sumitomo, possibly with five other Japanese trading houses, has taken of a big of the LME’s copper stock - estimates range from 30 - 60 percent”.

III. On December 6, 1991, the *Wall Street Journal* reported that David Trelkeld, a trader in the United States, had alerted the LME in writing that Hamanaka had asked him to confirm nonexistence traders.

## 2. The alleged manipulation in 1993

I. On July 23, 1993, the *Reuter European Business Report* noted that a copper squeeze “was going to be July, but they rolled it forward”.

II. On August 2, 1993, the *Independent* reported that: “metal traders are speculating about the presence of a large Far Eastern player, possibly powerful Sumitomo Corporation, whose control of a large amount of LME copper stocks may be pushing prices higher”.

III. On September 8, 1993, the *Reuter European Business Report* under the headline “World copper market squeeze prompts exchange curbs” reported that “A squeeze on world copper supplies prompted a London commodity exchange to impose price curbs on Wednesday but traders did not believe the market would fall in the near term”.

IV. On September 9, 1993, the *Financial Times* reported under the tittle “LME moves to relieve copper squeeze”.

V. On September 11, 1993, the *Financial Times* reported that: “the London Metal Exchange threw out a lifeline this week to investors struggling against the tide of support buying that has distorted copper market prices throughout the summer”, ... “(T)he culprit, the LME traders alleged, was the Japanese Sumitomo metals group, which they suggested might be preparing for a large-scale physical copper deal”.

VI. On September 18, 1993, the *Financial Times* proclaimed that “(T)he copper squeeze is over”.

## 3. The alleged manipulation in 1995

I. On Oct 17, 1995, the *Financial Times* reported under the tittle “Copper prices

tumble as squeeze fears evaporate” that “(F)ears that the copper market was about to be squeezed and prices sent soaring proved groundless yesterday as speculators made enough metal available to ease supply tightness and send London Metal Exchange price tumbling. ... That was accompanied by rumours that most of the 39,000 tonnes of copper in LME warehouses at Long Beach, California - more than 20 percent of total LME stocks - had been sold to Sumitomo, the Japanese trading house”.

II. On Oct 25, 1995, the *Financial Times* reported that: “The LME is the only reservoir of surplus refined metal that we know of, which is why some market reports say that about 30,000 tonnes of the Long Beach (LME)stocks are already controlled by Asian merchants”.

#### 4. The alleged manipulation in 1996

I. On May 11, 1996, the *Financial Times* reported under the tittle “Copper tightness continues:Week In The Markets” that “(T)he tightness continued to be reflected in a large cash premium, called a 'backwardation' because it is a reversal of the normal situation where cash prices are at a discount reflecting costs of holding physical metal - storage, insurance and lost interest. The backwardation eased by Dollars 13 yesterday to Dollars 105 tonne, compared with Dollars 116 at the end of last week”. It continued that “(T)he depth of the LME authorities' concern about the tightening supply squeeze was underlined in mid-week when Mr. David King, the chief executive, announced that the board had decided to impose a limit on the cost of carrying forward a short position for one day. Since Thursday holders of short positions who are unable to deliver copper have been required to pay a penalty equivalent to 1 per cent of the previous day's settlement price. At present that works out at around Dollars 28 a tonne, well above the Dollars 2 borrowing cost obtaining on the market before the LME board's action'. We can only assume that Mr. King saw something in the confidential daily reports which alarmed him and the action was to pre-empt a disorderly situation,'one analysts commented”.

II. On June 8, 1996, the *Financial Times* under the headline “LME pledges action on copper turmoil” that “(A)s battle raged yesterday between those determined to drive

copper prices down on the London Metal Exchange and those equally determined to push them up, Mr. David King, the LME's chief executive, promised that action was being taken to deal with the turmoil being created".

## Appendix B:

### Estimation of Forecast Errors with Overlapping Data

Consider a  $k$ -step forecast error at date  $t$   $e_{t,k} = f_t - E(s_{t+k} | \Phi_t)$ , where  $f_t$  is the forward price at  $t$ , and  $E(s_{t+k} | \Phi_t)$  is the expected price at  $t + k$  conditional on the available information at  $t$ . Since the sampling interval (daily here) is finer than the forecast interval (3-month), then  $E(e_{t,k} e_{t+h,k})$  will be serially correlated. Following Hansen and Hodrick (1980), we estimate the asymptotic covariance matrix. The procedures are as follows:

1. Calculate the daily  $k$ -step forecast errors and the mean forecast error.

$$\begin{aligned} e_{t+1} &= f_{t+1} - E(s_{t+k+1} | \Phi_t) = \sum_{i=1}^k \epsilon_{t+i+1} \\ e_{t+2} &= f_{t+2} - E(s_{t+k+2} | \Phi_t) = \sum_{i=1}^k \epsilon_{t+i+2} \\ &\vdots \\ e_{t+n} &= f_{t+n} - E(s_{t+k+n} | \Phi_t) = \sum_{i=1}^k \epsilon_{t+i+n} \end{aligned}$$

where  $n$  is the number of observations, and  $\epsilon_{t+i+n}$  is the one-step forecast error for date  $i$ .

The mean forecast error is:

$$\bar{e} = \frac{1}{n} \sum_{i=1}^n e_{t+i} = \frac{1}{n} \sum_{i=1}^n \left[ \sum_{j=1}^k \epsilon_{t+i+j} + \sum_{j=1}^k \epsilon_{t+i+j+1} + \cdots + \sum_{j=1}^k \epsilon_{t+i+j+n} \right]$$

2. Derive the asymptotic variance-covariance  $var(\bar{e})$ .

Assume  $E(\epsilon_{t+i}) = 0$ ,  $E(\epsilon_{t+i}^2) = \sigma_\epsilon^2$ , and  $E(\epsilon_{t+i} \epsilon_{t+i+h}) = 0$  for  $h \neq 0$ , therefore,

$$\begin{aligned} var(\bar{e}) &= \frac{1}{n^2} var\left(\sum_{i=1}^n e_{t+i}\right) \\ &= \frac{\sigma_\epsilon^2}{n^2} \left[ n + 2(n-1)\left(\frac{k-1}{k}\right) + 2(n-2)\left(\frac{k-2}{k}\right) + \cdots \right. \\ &\quad \left. + 2(n-k+1)\left(\frac{1}{k}\right) \right] \\ &= \left(\frac{k+1}{n}\right) \sigma_\epsilon^2 - \frac{2\sigma_\epsilon^2}{kn^2} [(k-1) + 2(k-2) + \cdots + 2(k-2) + (k-1)] \\ &= \left[ \frac{k+1}{n} - \frac{2 \sum_{i=1}^{k-1} i(k-i)}{kn^2} \right] \sigma_\epsilon^2 \end{aligned}$$

3. Calculate the asymptotic standard error  $\sigma_e$ .

$$\sigma_e = \sqrt{\left[\frac{k+1}{n} - \frac{2 \sum_{i=1}^{k-1} i(k-i)}{kn^2}\right] \sigma_\epsilon}, \text{ and } \hat{\sigma}_\epsilon = \sqrt{\frac{1}{n-1} \sum_{i=1}^n \epsilon_{t+i}^2}.$$

where  $k = 63$  in our case.

# Chapter 5

## Should Futures Regulation Raise Special Concerns: A Comparative Study of Futures Regulation in the US and the UK

### 5.1 Introduction

Formal futures trading has the longest history in the US and the UK. While futures contracts in these two countries are similar in nature, and functions performed by the futures markets are the same, but the objectives of regulation and major regulatory concerns have been different and the evolution of futures regulation in each country has followed distinct paths. Futures manipulation, excessive speculation and the welfare costs associated with sudden and unreasonable price fluctuations resulted from these activities have been the major concern in US futures regulation since the enactment of the first Federal futures legislation - the Grain Futures Act of 1922. But UK financial services (including futures) regulation was motivated by a series of financial failures in general financial services markets, and therefore its major objective was, not surprisingly, mainly



investor protection. The implication is that the cost-effectiveness of futures regulation and the behaviour of market participants might be different, and this could influence the structure and functions of futures markets, and affect their comparative competitiveness of futures trading business globally. The significantly different approaches to regulating futures trading in the US and the UK and the dramatic changes that have been occurring in futures trading, including the continuously increased size and scope of futures markets, globalisation of futures trading, the fast growth rate of OTC trading compared with on-exchange trading, and recent events (for example, the collapse of Barings, the alleged Sumitomo copper manipulation, etc.) which have occurred in world futures markets, have prompted many questions with regard to futures regulation. What is the precise rationale for futures regulation? Why are there two significantly different regulatory systems in these two countries? Is self-regulation sufficient in regulating futures markets? How may these two regulatory systems be evaluated? Are these systems sufficiently cost-effective to meet the challenges of futures trading? If not, which kinds of reforms might be desirable?

Futures regulation has been under debate for a long time in the US and the UK. In the US, there is growing scepticism about the importance and effectiveness of government regulation. Recent legislation pending before the Congress to amend the Commodity Exchange Act (CEA) involved dramatic deregulation of government oversight over futures markets, although this was resisted by the Commodity Futures Trading Commission (CFTC).<sup>1</sup> In the UK, by contrast, futures regulation has been criticised because futures trading was motivated by the same rationale (investor protection) and formed part of the same framework of regulation as other financial sectors. The new Labour government has been considering putting financial regulation on a statutory basis and giving more

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<sup>1</sup>Born, Brooksley, Chairperson, The Commodity Futures Trading Commission, *The Dangers of Deregulation*. Remarks before the Futures Industry Association's 22nd Annual International Futures Industry Conference (March 1997). The main proposed changes on federal government's oversight over future markets include: professional exemption; the Treasury Amendment; the exemption from the CEA for certain OTC derivative transactions.

emphasis to government regulation,<sup>2</sup> and announced a fundamental set of changes of the institutional structure of financial regulation in May 1997. The merger of banking supervision and financial services regulation in a single body, the Financial Services Authority (FSA), may signal a step to a more direct regulatory system in the UK. However, in debates on financial regulation both in the US and the UK, little attention has been given to the precise rationale for futures regulation, and comparative studies of the two contrasting futures regulatory systems are rare. It is therefore not surprising that there is little consensus on the direction of regulatory reforms. Stone (1981) analysed the principles of futures regulation. His “tripod” theory suggests that regulation of futures markets lies in: (i) protecting customers; (ii) regulating against the potential of abuses of concentration by large position holders; and (iii) regulating natural monopoly in futures exchanges and clearing houses. In spite of its brevity, Stone’s “tripod” theory that generalises reasons for regulating futures markets may be still valid today. Edwards (1981) gave the first comprehensive analysis of the rationale for futures regulation, which provided a maybe useful tool to evaluate the potential role of government regulation. However, he did not provide any guidance in explaining and evaluating the two existing regulatory systems in the US and the UK. Gemmil (1983) examined the economics of regulating futures markets in general and reasons why the approach to futures regulation in the US is so different from that in the UK. He suggested that main justifications for futures regulation are, protection of fraud and prevention of manipulation. While the less small investors and more internationalised products in the UK than those in the US may explain the need of greater regulation in the US. Anticipating the enactment of the FSAct of 1986, Anderson (1986) surveyed futures regulation as practised in the US and the UK, but he did not explore the rationale for futures regulation, and therefore he was unable to explain why there exist differences between these two futures regulatory systems. In any case, the futures markets and futures regulation have both changed

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<sup>2</sup>Mike O’Brien, Shadow Treasury Minister, claimed: “We will be ending self-regulation and creating direct-regulation”, the *Financial Times*, October 19, 1996.

drastically in both countries since these papers were written. Edwards and Edwards (1984) and Easterbrook (1986) specifically investigated the regulation of futures markets in relation to manipulation, but their views on whether self-regulation is sufficient to prevent manipulation differ significantly. Edwards and Edwards were inclusive on this issue, while Easterbrook concluded that exchanges could offer the optimal amount of precautions. However, Pirrong (1995a) argued that self-regulation is not sufficient in regulating futures markets. Their different conclusions on this issue are not surprising, since it appears that there has not been a comprehensive theory to explain either the susceptibility of a futures market to manipulation or the effects of manipulation. Based on the theoretical analyses and empirical evidences of futures manipulation in the previous chapters, here we proceed to explore the regulatory implications of manipulation on futures markets and undertake a comparative study of futures regulation in the US and UK. We aim to answer the following questions:

- Should futures manipulation raise special regulatory concerns?
- What is the rationale for the existence of the two contrasting regulatory systems in the US and UK?
- How may futures regulation in these two countries be evaluated?
- How may cost-effective futures regulation be achieved in the UK?
- Are both regulatory systems sufficiently cost-effective to meet the challenges currently taking place in financial markets?
- What kinds of reforms are desirable currently in the two countries?

The rest of this chapter is organised as follows. Section 5.2 discusses the objectives of financial regulation and the precise rationale for futures regulation. Section 5.3 contains a comprehensive comparison between the two futures regulatory systems in the US and the UK and also an evaluation of these systems based on the theory of futures regulation.

In section 5.4, we analyse especially how the UK futures regulation should be modified to concern futures manipulation, and also discuss potential regulatory reforms facing the US and the UK. The final section provides brief conclusions.

## 5.2 The Rationale for Futures Regulation

### 5.2.1 Justifications for financial regulation

We first consider the objectives of financial regulation in general. These are widely held to be:

- Protection of the payments system.
- Prevention of financial collapse, sometimes described as the avoidance of systemic risk.
- Curtailment of monopoly power and encouragement of competition.
- Customer protection, specially protection of the interests of the clients of a particular institution from fraud, negligence or excessive risk taking.
- Encouragement of best practice.

The first and second objective are held to be more relevant to banking regulation than to the regulation of financial services sectors, while the last three, possibly together with the second (which is considered as relevant to some specific non-bank financial sectors, see Mayer, 1994) have been seen as the objectives of regulation or supervision for financial services markets. In fact, the final issue is not specific to financial markets. The reasons for regulation and supervision of banks have four main dimensions: the central position of banks in the smooth functioning of an economy; the vulnerability of banks to run (Bernanke 1983; Diamand and Dybvig 1983; Baltensperger and Dermine 1987,

etc.); the nature of bank contracts; and the problems of moral hazard and adverse selection associated with the lender-of-last-resort role (Benston and Kaufman 1986; Lewis and Davis 1987). The issues involved in the regulation of non-bank financial services are largely different. The probability of systemic problems is believed to be considerably lower compared with banks, and in some areas, it does not exist at all (for example, fund management, life insurance business, etc., see Mayer, 1994); contagion and potential disruption of payments system are less likely; and the nature of contracts are different to those of banks. The market failures that justify bank regulation do not in general apply to most financial services business. It is therefore generally believed that the reasons for regulating non-bank financial services<sup>3</sup> mainly lie in: problems of asymmetric information; under-investment in information by investors because of the free-rider problem; potential principal-agent problems; and issues related to conflicts of interest and the highly complex nature of financial contracts where consumers are not equally equipped with an ability to assess quality. In fact, one type of financial services may differ greatly from other financial services, but little attention has been given to the precise rationale for regulating different financial services markets, especially futures (derivatives) markets.

### **5.2.2 How are these concerns relevant to futures markets?**

Futures markets are sometimes considered as conforming closely to the textbook model of perfect competition. In futures markets, the products (futures contracts) traded are standard, every contract (for a given underlying asset and time) is exactly the same, the performance of contracts is guaranteed by a clearing house, entry and exit are easy, transaction costs are small compared with other forms of trading, the supply of contracts is unlimited (at least prior to the maturity month), and information on prices is available prior to or immediately after each trade. This appears to leave little room for market failure and therefore, correspondingly little need for regulation. But in the real world,

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<sup>3</sup>Although systemic threats under certain circumstances may exist in some specific markets (see, for example, Goodhart *et al.* 1998, pp.12-14).

futures markets are the most heavily regulated markets. This gives rise to the questions:

- What is the precise rationale for futures regulation?
- How and to what extent are systemic risk, asymmetric information and natural monopoly concerns relevant in justifying the regulation of futures markets?

### **Asymmetric information**

Investor protection concerns arise mainly from information asymmetry. It is widely believed that financial markets are likely to be particularly prone to information problems for the following reasons. Firstly, unlike in the purchase and sale of goods, financial services involve on-going relations between clients and firms. Secondly, financial contracts are usually highly complex, and the quality of services supplied is frequently difficult to evaluate. Finally, financial services are typically associated with confidentiality, which may result in frauds with a greater likelihood than in other markets. These arguments remain valid in futures markets, although the first may be less relevant in futures (derivatives) markets than, for example, in securities markets.

As in other financial services sectors, investors in futures markets are in need of special protection, because investors are usually exposed to certain types of risk, including uncompensated wealth transfers (mainly fraud and misuse of investor funds); incompetence resulting from principal/agent problems; and negligence. Firstly, a futures market, like other financial sectors is particularly prone to fraud and misuse, because an investor delivers cash today in return for cash to be returned, under certain conditions, in the future. In virtually all other cases the buyer can inspect the good or service before parting with his money, but this is impossible in futures markets. Segregation of client money is therefore commonly used to overcome this problem. Secondly, principal/agent problems arise when the funds handed over by the principal to agent are used by the latter in a way that benefits itself, rather than the principal. For example, a principal is advised to place his funds into large long (or short) positions which are in the same direction with

the agent's; front-running; churning, etc. Finally, there is the probability of poor and negligent advice. This is not unique to financial sectors, and is also a problem in other professions, e.g. medicine, accountancy, etc.

Front-running, churning, dealing at off-market prices and pocketing the difference could be checked by proper rules of disclosure and a fully recorded trading process. Poor advice and negligence can be overcome by a combination of specialist education and authorisation. However, in practice, some principal/agent infractions, negligence in particular may be difficult to prove, and setting and enforcing rules, standards and codes of conduct is liable to be expensive and to some extent arbitrary. Moreover, attempts to compensate for these three types of risks may create adverse selection and moral hazard problems. Therefore, the balance between benefits and costs may in practice be hard to determine.

There are two opposite arguments on the issue of investor protection in futures markets. One is that futures markets are particularly complex such that small investors cannot expect to acquire sufficient knowledge to protect themselves, and it therefore seems necessary to protect the unsophisticated against losing money. Another is that futures participants are relatively more sophisticated than participants in other financial sectors, for example, securities industry, and therefore, the less protection will be needed in futures markets ("markets for consenting adults"). Both arguments are not in general valid. Finance is necessarily about risk, and therefore to regulate to eliminate risk from investors would be a policy of regulating away the essential functions of futures markets and futures contracts. However, this does not mean that some investors do not need to be protected, just because they are sophisticated. The main reason motivating investor protection is to correct the market failure which arises from asymmetric information problems, and which may result in fraud, misuse of client funds, incompetence and negligence.

## Externalities in futures markets

Systemic risk is a form of negative externality, and the existence of systemic risk provides the primary rationale for banking regulation. By analogy with banks, a prima-facie case for regulation exists where the functioning of one part of the financial system is essential to the remainder of the economy, and where interlinkages exist between the performance of different financial institutions. Systemic problems appear relevant to futures (as well as other derivatives) markets, although to a less extent than in banking.

Failures of one or more clearing members or large traders could seriously jeopardise the functioning of a clearing association and the operation of a futures market and the entire financial system. Bankruptcy of one or more sizeable clearing members or traders by imprudent behaviour may threaten the solvency of a clearing association, and all futures contracts which is backed by the clearing association may become worthless, and therefore, clearing associations act essentially like central banks to futures markets (Edwards 1984). The failure of a clearing house might undermine the futures market, and could have impact on the entire financial system. This was clearly one of the major concerns during the Barings event and over some serious manipulation cases, such as the Maine potato manipulation on the Nymex in 1976, the 'silver crisis' of 1980, the alleged Sumitomo copper manipulation,<sup>4</sup> etc. However, the risk resulting from the failure of dealer/brokers or clearing members or large traders to the stability of futures markets or whole financial system should not be over-estimated in futures markets, since margin requirements and marking-to-market practice provide the first line of defence against this risk. The probability of this risk is limited to the situation where there are large price jumps during a single trading day and some traders holding huge positions. However, the contagion effects from the failure of one member or large trader on other members or traders obviously exist in futures and other derivatives markets, because there exist significant linkages between brokers, dealers or clearing members and traders. The failure of one broker, dealer, clearing member or large trader may have serious consequences for

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<sup>4</sup>International Effort Seeks to Avoid Meltdown, the *Financial Times*, June 17, 1996.



others (see also Mayer 1989 and Miles 1992). For example, bankruptcy of a large trader may cause large jumps in futures prices, which increases the possibility of failure in other similar financial entities who hold large positions which are in the same direction as the large trader's.

Additionally, futures markets have become an integral part of financial system, and futures contracts or other derivatives are highly liquid financial instruments and increasingly traded and held by sizeable firms, including banks. Although highly leveraged trading and highly varied contracts facilitate efficiency of risk management, they posed important challenges to bankers. Futures (other derivatives) markets may increase systemic risk of banks if banking regulation sticks to the traditional balance-sheet supervision.<sup>5</sup>

Releasing on-exchange pricing information may be viewed as another form of externalities. Accurate information benefits everyone in the market or outside the market, since the marginal cost of reproducing the information is zero and it is almost impossible for the exchange to exclude someone from enjoying the information. Thus everyone should share its production costs, but there are clearly incentives to be "free-riders", which may undermine the exchange's efforts to ensure the exchange to produce pricing information accurately and timely.

Futures manipulation can be seen as a type of externalities. This may be the most important externality in futures markets and will be considered in details in Section 5.2.3 and 5.2.4.

Regulators, exchanges, and clearing associations have recognised these problems. Several rules and regulations have been designed to insure the solvency of clearing members, clearing associations and broker-dealers. Capital adequacy, marking-to-market procedures, margin regulations, trading halts, price limits, position limits are some of them. Proposed property rights of on-exchange information (Lee 1994) may enhance the ex-

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<sup>5</sup>Such a concern was clearly reflected in the remarks of Hendry Gonzalez (1993), the former chairman of the Banking Committee of the US House of Representatives: "I have long believed that growing bank involvement in derivative products is, as I say and repeat, like a tinderbox waiting to explode. In the case of many market innovations, regulation lags behind until the crisis comes, as it has happened in our case with S & L's and banks..." (Gonzalez, H. 1993, H3322).

change' incentives with regard to the release of reliable information, but may also limit the access to the information.

### **Natural monopoly**

Organised futures exchanges produce transaction services. Transaction services are produced more effectively in a liquid market. It is well known that the greater the trading volume, the more liquid the market is, and liquidity tends to be inversely related to the unit transaction costs in the market (Stone 1981; Edwards 1981; Telser 1981; Fischel and Grossman 1984 and Pirrong 1995a). Exchanges tend to incur fixed costs in monitoring a market, and in addition, there are increasing returns to scale in various other exchange operations, such as transmission of information about transaction prices, research and development of new products, clearing functions, etc. Most clearing houses are functional departments of the exchanges, although some clearing houses are separate organisations (for example, the London Clearing House Ltd. (LCH)). There are even stronger reasons to believe that there is potential for natural monopoly in clearing (Fischel and Grossman 1984).

If there is a continuous positive relationship between market liquidity and trading volume, a classic natural monopoly market failure presents. There may be three aspects of natural monopoly in futures markets: increasing returns to scale in a particular contract; increasing returns to scale in a particular futures exchange; and increasing returns to scale in clearing if the clearing function becomes a separate organisation. We have little well-established theory or clear evidence on these issues, but it is safe, at least, to conclude that unit costs of transaction decline with trading volume, and hence trading volume has important cost-reducing effects. Although natural monopoly is not necessarily immune to competitive entry, there are strong reasons to believe that it is costly to enter a market already served by an established contract, or to run a new or smaller futures market that faces a well-established market with high liquidity (recent mergers of futures exchanges in the UK and US provided good examples).

The implication of the existence of increasing returns to scale for futures regulation is that regulators find themselves in a dilemma in designing regulation with respect to the relationship between entry, competition, and market efficiency. Restriction of entry may exacerbate problems associated with economies of scale. Instead, free entry increases competition (with respect to both a specific competing contract and a particular competing exchange), but may result in a less liquid market, and hence a less efficient market.

### **5.2.3 Manipulation should be a major concern in futures regulation**

Systemic risk, asymmetric information and natural monopoly problems are not unique to futures markets, but futures markets are specifically susceptible to manipulation, which should become a major concern in futures regulation. Certain types of manipulation also exist in other financial markets, such as manipulation based on actions that change the actual or perceived value of the assets, or based on releasing false information or spreading rumors, etc., but these types of manipulation are clearly defined and made illegal by various rules of either government or exchanges and certainly by the CEA (see Section 1.5, Chapter 1). Market power manipulation which is the most significant form of manipulation in futures markets, especially a futures “corner” or “squeeze”, is the focus of our attention. This type of manipulation is most likely to occur in commodity futures markets, and potentially also in interest rate futures markets. Futures manipulation is a means of creating and exerting monopoly power to achieve super profits by exploiting futures delivery mechanism. Futures manipulation has been the major regulatory concern in the United States, which clearly has been the main purpose of federal futures legislation. However, since the start of futures trading there has been a controversy as to whether manipulation is inherent to futures markets, and whether it constitutes a serious market failure.

## **Futures markets are prone to manipulation**

Several theoretical works have been done on the issues of whether futures manipulation is an equilibrium phenomenon or just an exception and on what determines the susceptibility of a futures market to manipulation, see for example, Anderson and Sundaresan (1984), Newbery (1984), Kyle (1984), Jarrow (1992), Kumar and Seppi (1992), Pirrong (1995b), etc. But most of these models rely on some specific assumptions which are not realistic in the real world. In Chapter 2 and 3, we explored these issues more generally and demonstrated theoretically using two game-theoretical models that futures manipulation can occur in equilibrium under weak conditions: firstly, there is a large trader with market power in the market, and other traders have imperfect information about the presence of the large trader; and secondly, the marginal cost of increasing deliverable stocks to an amount which exceeds the competitive level is positive. The first condition is essentially the very function of futures trading, and the second one prevails in most commodity markets. Given these conditions, a large long trader can take advantage of the anonymity of futures trading, the camouflage of noise trading and the other traders' uncertainty about his presence in the market, to amass a large long futures position that exceeds normal level of deliverable stocks at the delivery point, and stand for delivery when the contract approaches maturity. The shorts, who are committed by the contracts have to pay the marginal cost of delivery or, equivalently, to deliver some quantity of the commodity, where the marginal cost of delivery has been inflated. The large long profits even after he takes into account of the costs of "burying the corpse". Moreover, whenever there is a positive probability of manipulation, the large long can profit in both ways: when a manipulation is not considered to be very likely by other traders, the large long can manipulate the market profitably; while the perceived probability of manipulation is high, he can speculate a market by shorting profitably. The susceptibility of a futures market to manipulation therefore depends on to what extent a manipulator can hide behind other traders and the delivery market characteristics. More importantly, asymmetric information and noise trading may facilitate a large trader's dynamic manipulative

strategies in a futures market (as modeled in Chapter 3).

In the real world, an ingeniously constructed manipulative scheme can be very complicated, which may involve several markets and financial instruments. As a US court observed that “(the) methods and techniques of manipulation are limited only by the ingenuity of the man”.<sup>6</sup> Manipulative schemes tend to become more complex as derivatives markets develop, and this may facilitate a manipulator in better concealing his manipulative initiatives better.

### **Manipulation affects adversely the “price discovery” and “risk-shifting” functions of a futures market**

These models also predict that manipulation has pronounced effects on the equilibrium pricing process through its effects on other traders’ expectations about the future cash prices. The equilibrium futures price is always the probability-weighted price of the marginal cost of delivery and the competitive price, and this will be a biased estimate of the future cash price from the point view of all market participants except the market makers. The unbiasedness for the market makers results from that fact that they are able to condition their trading strategy on their private information in relating to the net order flow. Since new uncertainty (probability of manipulation) is introduced into the pricing process, the variance of futures price is expected to increase due to manipulation. Manipulation also discourages hedging activities, which has important implications on the risk-shifting function of futures markets as well as on market liquidity. Manipulation affects welfare and the wealth distribution as well - there are dead-weight losses due to the distortion in patterns of consumption, transportation, and storage, and manipulation may elevate cash prices in the delivery market as well as the whole markets for the commodity, so owners of the deliverable stocks benefit, while purchasers of the stocks lose. Moreover, when there are frequent manipulations in a futures market, these effects are potentially enormous. In Chapter 4, we also tested the effects of Sumitomo copper manipulation

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<sup>6</sup> *Cargill, Inc. v. Hardin*, 452 F. 2d 1154, 1163 (8th Cir. 1971).

on the equilibrium pricing process and hedging, and found that manipulation affected the relationships between futures price and the future cash price, basis and basis risk consistently, thereby largely undermining the functions of the LME.

Futures manipulation is essentially the monopolisation in futures markets. In cash markets, monopoly means controlling the supply. By controlling supply below the optimal level, a monopolist sells his products at higher prices and earns monopoly profits. Monopoly thereby creates dead-weight losses for the whole society. A futures market is a slice of the market in the underlying commodity. A standard contract entitles the buyers to demand delivery of a specific commodity in a specific delivery point at some contracted period of time. Thus cross-substitution and intertemporal substitution are limited. The specific delivery date, narrow definition of the deliverable commodity and a large open interest compared with usually little actual delivery<sup>7</sup> as well as less deliverable stocks, are the very features that makes futures markets attractive to all types of traders. Due to the intrinsic characteristics, futures markets appear more simple to monopolise (Easterbrook 1986). Manipulation is monopolisation of futures markets, the consequence of manipulation is welfare loss, and this is a market failure in classic sense (Edwards 1981).

#### **5.2.4 Is self-regulation sufficient in regulating futures markets?**

Market failures in futures markets do not themselves suggest the form of regulation, nor who should be the regulator - self-regulatory bodies or government? External regulation is believed to be more costly than self-regulation, and hence external regulation is only desirable if it forces the regulated to do something they would not have done voluntarily anyhow. The crucial question is whether the private costs and benefits of self-regulatory bodies in correcting market failures in futures markets closely approximate social costs and benefits.

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<sup>7</sup>Hieronimus (1977, p.340) stated: "In [futures] markets that work, delivery is rarely made or taken, futures contracts are entered into for reasons other than exchange of title".

Self-regulatory organisations in futures markets include futures exchanges, clearing houses, and industry associations, such as the National Futures Association (NFA) in the US, the Securities and Futures Authority (SFA) in the UK. Let us focus on the exchange and clearing house for the moment. Numerous scholars (Edwards and Edwards 1984, Fischel and Grossman 1984, Easterbrook 1986, Kyle 1988, Fischel and Ross 1992, etc.) argue that an exchange, which may be seen as acting as a trading volume maximiser, is (almost) sufficient and efficient in ensuring the best practices of its members. It is undoubtedly true that an exchange or clearing house internalises many externalities that occur across its members, but our perception is that there is still a divergence of private and social costs (benefits) to regulation, which suggests self-regulation is not sufficient, and external regulation may be necessary in the area where the divergence exists.

There may exist systemic risk in an exchange or clearing house. Significant costs from the failure of an exchange or clearing house may be borne by parties who are not its members, although it is generally believed that its members bear most of the costs. The implication is that the exchange or clearing house may not have incentives to establish sufficient rules to prevent systemic risk.

The divergence of private and social costs may be significant in the case of manipulation. The major costs arising from futures manipulation are a reduction in the quality of hedging services, loss of accurate price discovery and an increase of volatility. Hedging services are accessed by direct or indirect (i.e. via OTCs) purchase of exchange products. A common view is that a deterioration in the quality of hedging services will reduce the demand for hedging, which will necessarily reduce trading volume, and that therefore an exchange has appropriate incentives to control the actions of its members and investors. This argument is not in general true. Firstly, manipulation does not necessarily result in a reduction of trading volume. Manipulation impairs hedging activities and reduces hedging volume, but it is possible that manipulation may invite speculators to the market because of the possible increase of volatility. It is therefore difficult to gauge whether manipulation reduces trading volume, since this depends on the structure of traders in

the market. Secondly, even if manipulation does reduce trading volume, it does not follow that exchange members bear the full costs. A backward shift in the demand for the services of the exchange due to manipulation may reduce producers' (exchange members) surplus, but it also reduces consumers' surplus. Therefore the exchange members share the costs from the reduced volume with their customers (Pirrong 1995a). Thirdly, even if conflict-of-interest problems do not exist to such an extent to prevent an exchange or clearing house from optimal actions against manipulation, and if there is no strong relationship between a reduction of trading volume and manipulation, manipulation may hurt the shorts, but not necessarily all other members even in the long run, and this creates conflict-of-interest among exchange members. One should not therefore expect an exchange to vote to put sufficient procedures in place which prevent manipulation.<sup>8</sup> Furthermore, an exchange or clearing house may fail to pass or enforce anti-manipulation rules because of rent-seeking activities which result from huge profits from manipulation. Under these circumstances, the manipulator may pay higher than competitive prices to avoid detection by the self-regulating authority, and this may also exacerbate conflicts of interests.

Price discovery is more problematic. The information is freely disseminated and exchange prices are accessible to firms and individuals who are not the members or even not the users of the exchange. If a price is widely disseminated but distorted due to manipulation, the commodity will be consumed at a point at which its marginal use value differs from its marginal social production cost, and there will be welfare losses. Therefore, price discovery generates an element of externality. An exchange may be insufficiently vigilant in suppressing manipulation, not because it is compromised, but because it bears the entire costs of regulation but does not capture all benefits. This suggests an exchange should be compelled to regulate manipulation somewhat more strongly than the exchange would itself choose.

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<sup>8</sup>It is more doubtful that an exchange will pass sufficient rules against manipulation when floor traders, who are motivated to become members by the substantial variations of prices, constitute an important parts of membership of an exchange.



The arguments above apply to most traditional futures exchanges which are run as co-operatives, in other words, they are run on behalf of their members, the people who use the exchanges (market makers, brokers, etc.). However, more recently some exchanges have been transformed onto public companies (such as the Stockholm Stock Exchange, the Stock Exchange of Amsterdam, etc.), and several other large securities and futures exchanges are rethinking their structure. The question is whether an exchange with outside ownership can do better in manipulation prevention than a co-operative. The general answer is yes, but still not sufficiently. One major distinction between a co-operative structure and outside ownership is that an exchange maximises different objective functions (for detailed discussions on the differences between the two ownerships, see Hart and Moore 1995). An outside owner simply instructs his manager to maximise profit, while a co-operative has a more complex objective, which most likely is to maximise the payoff of the median voter. This has important implications on the way of making decisions, rules, the fee structure, etc. The members of a co-operative exchange are interested in maximising their objective function and are interested only in so far as this contributes. If they earn more from manipulation than they lose through their share of the possibly diminished value of the exchange, they will continue to manipulation, or connive in manipulation. The shareholders of an externally owned exchange, by contrast, will only be interested in the value of the exchange. The outside ownership may therefore be more efficient in manipulation prevention if it expects that manipulation may diminish the value of the exchange. Moreover, outside ownership, such as public companies, as a form of exchange governance may reduce or eliminate the divergence between private and social costs than a co-operative under certain circumstances, for example, in a market with a greater competitive and a greater diversity of market users. But our view is that an exchange with outside ownership may be not sufficient in manipulation prevention, since certain amount of manipulation may not necessarily reduce the value of an exchange which depends on the structure of the traders in the market, and most exchanges are actually run under less competitive environment than an ordinary public company, which

limits the advantages of an outside ownership as a form of exchange governance. Firstly, there is natural monopoly problem in exchange market. Secondly, in practice it is costly to enter a market which is already served by an established contract, or to run a new futures market that faces a well-established market.

The above discussions show an exchange or clearing house may fail to internalise all externalities that occur across its members. The last question is whether the futures industry self-regulation can make up for these defects. It appears that industry self-regulation cannot do much better. It cannot internalise those externalities which spill over to other industries and non-members, such as the externalities discussed above which result from systemic risk, and manipulation, even though the industry self-regulation can be a mechanism to resolve inefficiencies arise from externalities across exchanges, and members. Moreover, industry self-regulation may indeed provide better protection for the public, but it has been criticised in that it always leads to a danger of capture, resulting in a situation in which regulators and practitioners collude to reduce potential entry and competition.

## **5.3 Futures Regulation in the US and the UK**

### **5.3.1 A comparison of futures regulation in the US and the UK**

Generally speaking, both futures regulatory systems in the US and the UK are, to a greater or lesser extent, a blend of statutory regulation and self-regulation, although the US system is considered to place more reliance on statute. However, the organisational aspects of these two regulatory systems are quite different.<sup>9</sup> One significant distinction is that futures regulation in the US has been treated separately from regulation of securities and other investment business, while the UK system does not give special status to concern relating to futures markets (as well as other derivatives markets). Furthermore,

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<sup>9</sup>In the appendix of this chapter, we provide a detailed description of the futures regulatory structures in the US and the UK. A brief comparison is listed in Table 5.1.

the backgrounds motivating regulation are different (in the US the motivation of the GFA and CEA was futures manipulation and excessive speculations, while in the UK the motivation of the passage of FSAct was the significant financial failures which resulted in misappropriation of client funds), and futures markets in the US and in London traditionally exhibited distinct characteristics. It is therefore not surprising that there exist significant differences in the aspects of specific regulations under these two regulatory regimes.

### **The scope of futures regulation**

The CEA provides statutory basis for US regulation of futures markets and derivatives markets. Under the CEA, all goods for which contracts are for future delivery are considered as commodities with only a few exclusions,<sup>10</sup> and must be confined to designated exchanges. The CFTC has exclusive jurisdiction ‘with respect to accounts, agreements, and transactions involving’ futures contracts and options traded on or subject to the rules of exchanges and other markets.<sup>11</sup> But a precise definition of “contracts for future delivery” is not given legislatively, and this has given rise to a number of problems in determining whether a particular contract is a regulated commodity futures or unregulated commodity forward contract. Nevertheless, there is no doubt that the CFTC has authority to regulate all on-exchange futures markets in the US. The UK futures legislation follows a rather different path from the US counterpart. The FSAct does not assume that the best means of regulating futures (including forward) contracts is to ensure that they are undertaken on an exchange. The fact that a contract is entered into off-exchange does not prevent it from being regarded as an “investment”.<sup>12</sup> Whether a

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<sup>10</sup>The CEA contains two exclusions: the forward contract exclusion and the Treasury Amendment. The first excludes the CFTC’s jurisdiction over the “sale of any cash commodity for deferred shipment or delivery”. The second provides that: “nothing in this Act shall be deemed to govern or in any way be applicable to transactions in foreign currency...unless such transactions include the sale thereof for future delivery conducted on a board of trade” (the CEA s 2(a)(1)(A)).

<sup>11</sup>CEA, s 2(a)(1)(A).

<sup>12</sup>The main provision (paragraph 8, schedule 1) of the FSAct which refers to futures covers forward contracts as well as futures. The SIB interpreted that the contract in that paragraph is a contract: (i)

forward contract should be excluded from the FSAct provisions depends on whether its purpose is commercial or investment. The FSAct provides that if delivery is intended to be given or taken, then that is an indication of commercial and not investment purpose. However, there are difficulties in distinguishing between the two because the criteria involve intent.<sup>13</sup> The FSAct requires that certain types of transactions be regarded 'as made for investment or commercial purposes', and then sets out certain 'indications' as to whether other types of contracts are to be so treated. The Securities and Investment Board (SIB)<sup>14</sup> regards them as conclusive investment contracts if they are either made or traded on a 'recognised' investment exchange, or made otherwise but expressed to be as traded on such an exchange or on the same terms as those on which an equivalent contract would be made on such an exchange.<sup>15</sup> In theory, the UK's approach to regulating futures under the 'investment' is therefore much broader and less subject to controversy than that of the US under the 'commodity'.

From the above discussions, there seems to have a little difference in these two regulatory systems on the treatment of on-exchange futures, and an attempt has been made to exclude commercial contracts from regulation both in the US and the UK. But the implication of these different regulatory approaches on how to regulate the rapidly innovated OTC derivatives markets is dramatic. Obviously, if an OTC contract did not fall within one of the two exclusions, it would be unenforceable in the US, and this has plagued the US markets in currency swaps and other modern inter-bank instruments that are settled without delivery or bear similarities to exchange-traded futures and options.

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for the sale of a commodity or property of any other description; (ii) under which delivery is to be made at future date; (iii) at a price agreed upon when the contract is made (SIB Guidance Release 3/88).

<sup>13</sup>Schedule 2 of the FSAct provides that a contract is deemed commercial: (i) it involves a party that produces or uses the goods; (ii) it is traded off of a recognised futures exchange; (iii) delivery is intended; and (iv) some of the terms in addition to price are negotiated by the parties.

<sup>14</sup>In October 1997, the SIB was renamed to the Financial Services Authority (FSA), the single financial regulator in the UK. However the FSA will not assume full responsibilities until the enactment of a proposed financial regulatory reform bill (expected to be late 1999). Before that, the other constituent bodies (for examples, SIB, SFA, etc.) will continue to have legal responsibilities for regulating their firms under the original statutory or contractual arrangements. Therefore, we sometimes still refer to the constituent bodies' original names when discussing and describing the UK financial regulation.

<sup>15</sup>SIB Guidance Release 3/88, Note 2.

Internal pressures from the markets, and competitive disadvantage in global markets, led to gradual exemption of almost all of OTC contracts from jurisdiction under the CEA. OTC forward contracts, such as swaps, caps, floors, collars, interest rate options, currency and debt securities options are therefore excluded from the CFTC's jurisdiction. The situation in the UK is somewhat complicated. In order to avoid being caught by the definition of futures, a contract governed under the FSAct must be entered into for 'commercial and not investment purposes' and must not incorporate terms typical of an exchange-traded contract. Additionally, it must not be a 'contract for differences'<sup>16</sup> or an option on financial instruments. The major exceptions to the FSAct are spot, forward currency contracts and listed money market institutions. Therefore, the UK regulation of OTC forward markets is in principle more inclusive than the current US model.

One important feature of US futures regulation is that special concerns have been given to the regulation of extra-territoriality. Although there is no restrictions except for a small number of exceptions<sup>17</sup> on the types of non-US futures products that may be offered or sold to US customers, a non-US person who seeks to trade futures in the US must become a customer of an FCM and must execute a large number of agreements and acknowledgments. If the number of futures positions carried by that customer exceeds the CFTC or contract market specified reporting levels, the FCM is required to furnish the identity of the customer to the CFTC and the applicable contract market, and advise them of such positions and changes. A non-US person is therefore subject to the same types of large-position regulation as US customers. Moreover, the US courts have jurisdiction over a non-US person's trading on a US contract market, regardless of the status of the intermediary under the CEA (whether the intermediary is a non-US branch office of a US FCM, or non-US agents of a US FCM, or a non-US subsidiary of

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<sup>16</sup>A contract for differences is a contract whose purpose is to secure a profit or avoid a loss by reference to fluctuations in the value or price of [any] property...index or other factor designated for that purpose....

<sup>17</sup>There are two exceptions: (i) non-US stock index futures may be offered or sold in the US only if the CFTC has issued on-action letter (provided on a case-by-case basis); (ii) futures contracts on non-US Government Debt Obligations may be offered or sold in the US only if the underlying obligation is designated as an exempt security under SEC, Rule 3a 12-8.

a US FCM). In addition, US courts have been liberal in subjecting non-US parties who engage in the transactions with US persons to sue in US courts. In general, regulation of non-US persons engaging in futures transactions in the US contract markets is inclusive in the CEA and CFTC regulations. However, this is not true in the UK. With the exception of non-investment business engaged in the UK by non-UK persons, many types of investment business which are actually carried on the UK fall outside the scope of the FSAct if the firm does not have a UK office from which it carried on the investment business.

## Manipulation

The significant different approaches to regulating securities markets and futures markets in the US are premised on the contention that futures manipulation is significantly different from manipulating securities markets. For this reason, the fundamental concern of futures regulation in the US is futures manipulation. The Grain Futures Act, the first statute on the regulation of futures markets took the view that “futures transactions are susceptible to manipulation and control, and may generate sudden and unreasonable price fluctuations”.<sup>18</sup> The fundamental purpose of the CEA is “... to provide a measure of control over manipulative activity... that demoralise(s) the market to the injury of producers and consumers and the exchanges themselves”; that price fluctuations due to manipulation “... are a burden upon interstate commerce and make regulation essential in the public interest”.<sup>19</sup> The CEA and all futures regulations that proceeded it in the US explicitly make manipulation a felony. Section 9(b) of the CEA makes it a felony punishable by a fine up to \$500,000 (\$100,000 for individuals) and imprisonment of not more than five years, for any person “to manipulate or attempt to manipulate the price of any commodity in interstate commerce, or for future delivery on or subject to the rules of

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<sup>18</sup>Grain Futures Act, Pub. L. 331, 42 Stat. 998 (1922).

<sup>19</sup>Futures Trading Act of 1978, Committee Print, Committee on Agriculture, Nutrition, and Forestry, US Senate, 95th cong., 2nd sess., 136 (Jan. 1979); Senate Report No. 95-850, 95th Cong., 2nd Sess., 5-13 (1978). See also Edwards and Edwards (1984, p.333).

any contract market, or to corner or attempt to corner any such commodity...".<sup>20</sup> However, manipulation is not explicitly defined by statute, and the task of interpreting the term is left to regulators and courts. Edwards and Edwards (1984, p.336) summarised the US judgements as interpreting manipulation as "the creation of an artificial price by planned action, whether by man or a group of men";<sup>21</sup> these actions must be "calculate to produce a price distortion";<sup>22</sup> and the "intent of the parties during their trading is a determinative element of a punishable manipulation".<sup>23</sup> Put in other words, in order to prosecute manipulation, three elements are necessary: (i) price artificiality; (ii) causation; (iii) intentionality. Unfortunately, the relevant court decisions have not established firm and defensible criteria for whether a particular price is artificial, or whether an accused trader intended to cause that price.

The CFTC was authorised and has established several measures to deal with manipulation. The most important of these include: (i) the CFTC imposes daily trading and position limits for speculators; (ii) the CFTC imposes upon all boards of trade, as a condition for designation as a contract market, that their governing boards must provide for "the prevention of manipulation of prices and the cornering of any commodity by the dealers or operators upon such board";<sup>24</sup> (iii) the CFTC is legislatively instructed not to authorise trading in a new futures contract unless the exchange has demonstrated that the contract terms are not prone to manipulation; (iv) the CFTC is empowered under the Section 8a (6) of the CEA to communicate to the contract markets "the full facts concerning any transaction or market operation, including the names of the parties thereto, which in the judgement of the Commission disrupts or tends to disrupt any market ...", and Section 8a (7) to alter or supplement contract market rules under various circumstances, including "for the protection of traders or to insure fair dealing in commodities traded for future delivery on such contract market". Under Section 8a (9), the CFTC is

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<sup>20</sup>7 U.S.C. Section 9.

<sup>21</sup>*General Foods Corporation v. Brennan*, 170, F.2d.220, 231 (7th Cir.1948).

<sup>22</sup>*Volkart Bros. Inc. v. Freeman*, 311, F. 2d. 52, 58 (5th Cir. 1960).

<sup>23</sup>*General Foods Corporation v. Brennan*, 201, F.2d. 476, 479 (7th Cir. 1948).

<sup>24</sup>CEA, Section 5(d).

given emergency powers to intervene directly into contract markets where there is "... threatened or actual market manipulation and corners ..."; (v) Section 4i of the CEA makes it unlawful for any person who owns or controls an open futures position which equals or exceeds an amount fixed by the CFTC, to trade on a contract market, unless such person files large trader reports with the CFTC, and keeps books and records of cash or spot transactions relating to his futures position.

In contrast to the US position, where manipulation is illegal under the CEA, and where the CFTC has an explicit obligation to act against this practice, it does not appear that the relevant provisions in FSAct makes futures manipulation illegal. However, whether futures manipulation is explicitly prohibited by the FSAct is subject to further legal interpretation. Moreover, it seems unlikely that other relevant laws relating to futures trading in the UK have been made manipulation illegal. The main law with regard to prosecuting investment frauds is the Prevention of Frauds Investment Act of 1958 (PFI), but is not applicable to futures business.<sup>25</sup> Prosecuting authorities have therefore to rely on general offences under the Companies Act 1985, and Thefts Acts 1968 and 1978. It remains true, however, nowhere is futures manipulation explicitly mentioned in any of the relevant Acts. The SIB took the view that manipulation is covered by Section 47 of the FSAct (SIB 1996, p.21). The three subsections in Section 47 of the FSAct, which do not explicitly refer to futures manipulation, make the following activities illegal:

(1) knowingly or recklessly making misleading, false or deceptive statements, promises or forecasts or dishonestly concealing facts;

(2) engaging in any course of conduct which creates a false or misleading impression as to market price or value of any investment if done for the purpose of inducing another person to trade in these investments, or refrain from doing so;

(3) provided that the person accused of an offence under the above subsection cannot show that he reasonably believed that these consequences would not follow.

These provisions clearly make certain forms of equity market manipulation illegal,

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<sup>25</sup>See also footnote 51.



such as “fan club” and “concert party” manipulations in which agents are induced to purchase shares with the effect that their prices exceed underlying values. It also makes the first two categories of manipulations as classified by Allen and Gale (1992),<sup>26</sup> unlawful. It seems doubtful whether the courts would sustain a more general interpretation of this Section of the FSAct such as would make futures corners and squeezes illegal.

Futures corners and squeezes typically do not involve a manipulator in making statements, promises or forecasts, and since there is no obligation on futures clients to reveal their positions (unless they are covered by certain large position reporting systems, such as the CFTC’s large position reporting program. There is no official reporting program in the UK, however, there are some relevant requirements imposed by some exchanges, such as the LME, which requires its members to report both proprietary and customer positions over a certain size in both futures and options), they cannot be accused of dishonestly concealing facts. In fact, concealment of a trader’s position is one of the most attractive features of futures markets, which may be beneficial to every trader in the market. Concealment of speculators’ positions may be useful in obtaining profits from their ability to predict futures demand and supply, while hedgers may also need this secrecy to avoid revealing their commercial policy (Fischel and Ross 1992, p. 545). Subsection 1 is therefore largely irrelevant to futures markets. The questions remained therefore are: (i) whether a corner or squeeze constitutes a conduct which might create a false or misleading impression as to market prices or values; (ii) whether the conduct is with the purpose of inducing another person to trade in these investments, or to refrain from doing so.

It is arguable that the first part of this condition is satisfied, since “price artificiality” is an essential element of the US juridical definition of manipulation. However, it is more difficult to argue that the intention of manipulation is to induce or inhibit trades. It

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<sup>26</sup>Allen and Gale classify market manipulations into three categories: action-based manipulation, where manipulation based on actions that change the actual or perceived value of the assets of the firm; information-based manipulation, where manipulation based on releasing inside information or spreading false rumours; trade-based manipulation, where manipulation due to transactions, without taking any actions to alter the value of the firm or to release false information which changes its value.

is clear that the intention of manipulation is to create favourable terms of trade, which does not necessarily involve any actions of inducing or inhibiting shorts to trade, since shorts are motivated to futures markets by their expected future cash price at the time of contracting, their risk aversion and their risk exposures in cash markets. It might be argued that the shorts would normally wish to close out their positions, but are obliged by the manipulator to deliver. In practice, however, successful manipulations typically result in the shorts closing out their positions before contract expiration, but on considerably less favourable terms than they had anticipated. This suggests that futures manipulation, at least the most common form of manipulation - the futures "corner" or "squeeze", will not in general fall under the FSAct. This is however subject to legal interpretation of the FSAct by its designated regulatory body and English courts.

An alternative possibility is that manipulation may be deemed illegal as conflicting with the SIB Principles. In particular, the context in paragraph 3.18 of SIB (1996) suggested that there might be a conflict with the third principle which required "a firm should observe high standards of market conduct". The SIB (1993) interpreted this as requiring the firm engage only in "proper trades", and argued that trades aimed at manipulation would be improper. However, none of the examples of improper trades in this guidance is relevant to futures manipulation, and more important, this guidance was not a legal interpretation of the statutory manipulation ban (Gilbert 1996).<sup>27</sup>

However, the FSA, new financial regulator in the UK, will take a big step in making futures manipulation illegal more explicitly in the UK. The Code of Market Conduct (FSA consultation paper, June 1998) set out certain types of manipulative activities as the breach of the basic precepts set out in the legislation (presumably the FSAct) in

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<sup>27</sup>SIB (1993) states: "In SIB's view, the guidance is also relevant to the market manipulation ban in Section 47(2) of the Act (the FSAct). That ban is concerned with ensuring that acts and courses of conduct are not intended to create a false or misleading impression as to the market in or the price or value of any investments. In order for the prohibition to be broken, a number of elements need to be fulfilled including elements concerned with the purpose of the act and the course of conduct. One way in which a false or misleading impression may be created is by effecting some of the improper trades described in this paper ... However, this guidance does not attempt to provide a legal interpretation of the statutory ban".

paragraphs 4.3 and 4.6: abusive squeezes and demand-side manipulation:

paragraph 4.3 A person improperly manipulates a market, where he -

- has a significant influence over the relevant supply of a product or the delivery mechanisms of a market in the product;
- has entered into deals on a designated market under which he has the right to require others either to deliver to him (or those colluding with him) quantities of that product or to take delivery from him (or those colluding with him) quantities of the product; and

then uses the first two circumstances to dictate arbitrary and abnormal prices for the settlement or release of the obligations to him (or those colluding with him) arising under those deals.

paragraph 4.6 A person should not enter a transaction or series of transactions in an investment or a reference commodity the principal purpose of which would reasonably be regarded as the positioning of the market price of a protected investment at arbitrary and abnormal level dictated by that person.

Any manipulative activity has to be assessed only on an examination of all the circumstances surrounded the conduct in question, and therefore, which kind price level can be deemed as abnormal prices and which types of activities can be seen as manipulation will have to be tested in actual hearings.

It is clear, unlike the case in the US, that the FSAct did not create powers specially aimed at detecting and preventing futures manipulation. The SIB, the FSA in the near future, unlike its equivalent part in futures regulation in the US, the CFTC, does not have any statutory power to monitor contracts markets<sup>28</sup> and intervene into the markets when necessary. It does not seem to have any expertise or personnel competence to do that. Therefore, all the tasks were left with the self-regulated organisations - the SFA,

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<sup>28</sup>SIB can have access to information on positions of exchange members, but this information does not reveal beneficial ownership.

and futures exchanges in the UK, however, no explicit anti-manipulation rule has been required by statute for a Self-regulating Organisation (SRO) or a Recognised Investment Exchange (RIE).

### **Investor protection**

It is commonly believed that the major concern motivated the FSAct was the investor protection, does it follow that the futures regulatory system in the UK provides better investor protection than in the US? Which one provides the optimal protection? Our perception is that, it is not generally true that the British system provides greater investor protection than the US system. Some measures of investor protection are imposed by the British system but not in the US, for example, 'know your customer', churning, and the Investor Compensation Scheme, while some are required by the US system but not specifically in Britain, for example, time-stamping, equal sharing rule,<sup>29</sup> various anti-manipulation rules, etc. It is also doubtful that whether rules relating to 'knowing your customer' and churning can be effectively applicable because of the nature of futures trading. The following analysis aims at a comprehensive but by no mean exhaustive comparisons of investor protection in the US and UK futures markets.

In the US, firms and individuals handling customer funds, must apply for registration and membership with the National Futures Association, and are subject to capital requirements set by the CFTC, especially the Futures Commissions Merchants (FCMs). The NFA was authorised to monitor financial conditions of FCMs, and is responsible to implement the requirement that customers' funds are kept in segregated trust funds. The insurance protection was proposed but not adopted by the CFTC, however, the Bankruptcy Act of 1978 contained provisions<sup>30</sup> governing the insolvency of a FCM in case that the FCM breaks such trust - conversion of the funds. Firms carrying on investment

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<sup>29</sup>See footnote 30.

<sup>30</sup>The provisions in the Bankruptcy Act of 1978 mainly provide for the equal sharing of all customers in any remaining segregated funds, i.e., every customer will receive a pro rata share of the remaining customer funds, and customers have a priority over all other creditors in such funds.

business in the UK are ensured by the SIB Principles to maintain adequate financial resources, and are subject to capital requirements by the SFA for all categories of its members, in particular for the Ordinary Business Investors (for some firms, the capital requirements may be directly imposed by the SIB). In order to protect investors against a SFA member's default, a SFA member has to comply with the SFA's Client Money Rules unless an exception applies.<sup>31</sup> Under the rules, an investor's money is required to be held with certain approved banks and that the money in the account is, to the bank's knowledge, a trust fund. However, a 'non-private customer'<sup>32</sup> may contract out of the protection (opt out of segregation), and a private customer with sufficient experience, and certain customers may be treated as a non-private customer in accordance with the SFA's rules. Unlike in the US, the SIB additionally established the Investors Compensation Scheme in 1988, under which a private investor can claim for compensation up to £48,000 due to the 'default' of regulated investment firms except those investors who choose to opt out of segregation.

The Futures Trading Practices Act of 1992 generally prohibits dual trading except where a specific exemption is granted,<sup>33</sup> and the CFTC established regulations to ensure that abuses on the trading floor would be eliminated. Exchanges are required to have rules of prohibiting floor brokers and futures commission merchants from trading for their own accounts ahead of customers, from unauthorised trading, and from disclosing orders of customers to others except to the extent necessary for their effective execu-

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<sup>31</sup>The exemptions apply to several kinds of firms, including one which is subject to the provisions of a Home State regulator under the passport of the European Union. Another exemption applies to money held by an approved bank on behalf of a customer in an account with itself.

<sup>32</sup>Under the SFA rules, non-private customers mainly include: i) ordinary business investor; ii) individuals who are acting in the course of carrying on investment business; iii) expert private customers; iv) some special small business investors.

<sup>33</sup>The Futures Trading Practices Act of 1992 (FTPC) requires the CFTC to ban dual trading except where a specific exemption is granted. For examples, specific floor traders are allowed dual trading for the execution of spread transactions, error corrections and customer authorised transactions; dual trading is allowed in an exchange where its audit trail met certain requirements, including timing of execution within one minute increments, or where dual trading was shown to be needed for liquidity purposes, or where the trading volume for specific contracts falls below a minimum average trading level, etc.

tion. In order to be able to detect abuses from dual trading, exchanges are required to have customers orders time-stamped in a manner that would allow an audit trail on a minute-to-minute basis.<sup>34</sup> Unauthorised trading is prohibited, the CFTC requires written authorisation from customers who gave trading discretion over their accounts to a commodity professional. In addition, commodity professionals are required to supervise their employees to prevent fraudulent practices. Dual trading has also been permitted since the 'Big Bang' in Britain, and one of the concerns of the FSAct is that investors will be adequately protected from abuses which may arise from dual trading. Under the SIB rules an investment firm acting as the agent for a client is obliged to assure that transactions are effected on the best terms available, and is required to process a customer's order before its own. For the abuses of dual trading to be detected, an exchange is required by the FSAct<sup>35</sup> as a condition of a RIE to either itself have or secure the provision on its behalf of satisfactory arrangements for recording of the transactions effected on the exchange. In contrast to the CFTC, neither the FSAct nor the SIB rules specify standard procedures for the trading records taken on an exchange. As in the US, discretionary futures trading is permitted in the UK and investment firms have to follow the SFA rules on customer agreements for such trading accounts. The CFTC proposed prohibition of churning in futures trading in 1977, but this practice has not been adopted in the US regulatory system, while it is explicitly prohibited by the SFA rules.<sup>36</sup> However, it is doubtful how effective the rule is in practice, because futures markets are very volatile, and a more active investment strategy is likely to be necessary in futures markets.

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<sup>34</sup>The CFTC in 1976 required contract markets, at minimum, to establish a 'bracketing' system, under which coloured-coded order tickets were used that allowed a determination of the execution time within a half-hour period. In January 1986, the CFTC announced the adoption of rules that would require a record of the execution time of orders in one-minute increments, and exchanges were required to comply with the rule by October 1, 1986.

<sup>35</sup>Requirements for Recognition of Investment Exchange, Schedule 4 of the FSAct.

<sup>36</sup>Rule 5-43 of the SFA provides that a firm must not make a personal recommendation to a private customer to deal, or to arrange a deal in the exercise of discretion for any customer, if the dealing would reasonably be regarded as too frequent in the circumstances. For a detailed discussion, see Parry, Bettelheim and Rees (1996), Chapter 1, p.17.

In September 1977 the CFTC proposed a 'suitability' requirement for brokers, but this was not adopted, and courts have refused to imply such a duty.<sup>37</sup> In the UK, the FSAct does not specially require that an authorised firm determine the 'suitability' of an investment for a customer, but the SIB rules contain a "know your customer" rule. Suitability is therefore written into the SFA rulebook,<sup>38</sup> although there is no guidance as to the meaning of suitability or what level of information should have been obtained from investors. Both regulatory systems require the registration of trading professionals. In the US, the NFA is responsible for registering all categories of professionals handling customer funds and require them to pass a proficiency exam. There are more general powers to regulate professionals dealing with the public. SIB (FSA in the near future) directly recognises and supervises nine Professional Bodies (RPBs), which are required to be 'fit and proper' to do investment business with the public.

Unlike investors in securities markets, neither in the US and UK do futures customers receive information about the underlying assets, nor are firms or individuals in general obliged to publicly reveal information about their positions. But both require that, before a customer can transact in futures, he must receive and sign a statement describing the risks or risk warning notice in futures trading.<sup>39</sup> There are no special provisions to prevent insider trading, but the CEA explicitly prohibit personnel of the CFTC from futures trading (Markham 1987, pp.70-71).

It is notable that the CFTC was authorised by the CEA to imposed a maximum imprisonment term of five years, a civil penalty up to \$100,000 for each violation of the Commodity Exchange Act, and special provisions in the statute governed the manner in

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<sup>37</sup>See, for example, *Avis v. Shearson Hayden Stone, Inc.*, Comm. Fut. L. Rep. (CCH) 21,379 (CFTC 1982).

<sup>38</sup>The SFA suitability rule provides a firm must take reasonable steps to ensure that it does not make any personal recommendation to a private customer of an investment or investment agreement, or effect or arrange a discretionary transaction with or for an customer, unless the recommendation or transaction is suitable for him. . . . See Parry, Bettelheim and Rees (1996), p.13.

<sup>39</sup>Rule 5-30(2) of the SFA requires that in respect of a warrant or derivatives, before a firm recommends, arranges or executes a transaction, it must have sent the private customer a Warrants or Derivatives Risk Warning Notice, and obtained a copy signed by the customer. See Parry, Bettelheim and Rees (1996). p.11.

which the amount of the penalty was to be determined, exchanges have the powers to fine their members. But neither the SIB nor SROs is empowered by the statute to impose civil penalties, although futures exchanges have powers to fine their members.

The comparison of futures regulation between the US and the UK (see also Table 5.1) can be summarised as follows:

- Both regulatory systems are a blend of statutory regulation and self-regulation, but British regulation relies less on statute and more on self-regulation. The US futures regulation has been developed on its own path, and has been separated from regulation of other financial sectors; while futures (derivatives) markets have not been a special regulatory concern in the UK, and it is likely to be more blurred under the mega regulator - the FSA unless there will be statutory reforms (Goodhart *et al.* 1998, p.153).
- The scope of futures regulation is broader and less debatable in the UK. The UK regulation of OTC derivatives is more inclusive than the US model, but the regulation of extra-territoriality falls out of the scope of the FSAct.
- Manipulation has been a fundamental concern in the US futures regulation, and made unlawful under various versions of futures legislation. The CFTC has an explicit obligation to act against this practice. But futures manipulation has not been made illegal explicitly under either the relevant provisions of the FSAct, or the SIB principles, but the FSA will potentially act to regard futures manipulation illegal.
- Both systems have similar treatments in relating to investor protection, although they are not without differences. Some are covered by the US system but not in the UK system, and *vice versa*. It is therefore difficult to judge which system provides broader and more effective investor protection.



### 5.3.2 An appraisal of futures regulation in the US and the UK

The brief description of current regulatory systems in the US and the UK in the Appendix of this chapter shows that there exist important differences between them, both in the institutional structures and in the emphases and details of specific rules. It is generally suggested that US futures regulation under the CEA is concerned, first and foremost, with futures manipulation, while UK financial regulation under the FSAct is concerned with protecting investors from abuse, incompetence and negligence. In fact, both have far broader objectives; futures markets are more heavily regulated by statute and government in the US than in the UK; futures regulation is separated from the regulation of other financial sectors in the US, both by statute and by institutional arrangements, but not in the UK. However, it is not straightforward to answer the question of which regulatory system is superior. An evaluation of a regulatory system requires that we answer two essential questions: whether futures markets are effectively regulated to correct market imperfections or market failures as discussed in Section 5.2, and whether the regulatory system is cost-efficient to achieve its objectives. One might immediately be sceptical that a single statute - the FSAct - could effectively establish principles simultaneously to cover various investment businesses in the UK. Despite the voluminous nature and complexity of the FSAct, it is not surprising that criticisms and objections have been made that it has insufficient flexibility to address adequately the specific forms of market failures that arise in very different markets (Miles 1992, p.172). For example, the failure of a broker/dealer might trigger a systemic problem, but it is unlikely that the insolvency of investment managers raises systemic concerns if client funds are separated from their own; information asymmetry is less vital in wholesale markets than in retail markets, and therefore, the level of investor protection in wholesale markets should not be the same as that in retail markets, etc.

Futures markets (and other derivatives markets) indeed have some characteristics that other financial markets do not have, for example, leveraged trading, high volatilities, susceptibility to manipulation (especially in delivery-settled markets), the special

Object-ives	Measures designed to achieve the outcome	US	UK
maintain competition, financial integrity market stability	Recognition of futures exchanges	yes	yes (domestic)
	Recognition of clearing houses	no	yes (domestic)
	Financial requirements for SROs' members	yes	yes
	Continuous (or periodic) surveillance of financial conditions of members	CFTC oversees SRO surveillance programs	no
	Early warning program on broker/dealer's financial crisis	relevant person is required to notify CFTC within 5 days imposed	no
	Price limits, circuit breakers	managed by exchanges	exchanges rules vary
	Emergency intervention into markets	yes (the CFTC)	no
protect investors	Minimum requirements for futures professionals	yes	yes
	Prohibition of dual trading	yes, but with broad exemptions	no
	Segregation of customer funds	yes	yes
	Prohibition of churning	no	yes
	Existence of investment insurance	no	yes (to private customers)
	Requirement of 'suitability'	no	yes
	Requirement of disclosure	no	no
	Prohibition of insider trading	no, but with some exceptions	the EC Insider Dealing Directive applies
	Restrictions on fees, cold calls	no but CATCH has guide-lines on phone solicitation	no restriction on fees but on calls
	Existence of reparation programs for investors	yes	yes
anti-manipulation	Is manipulation illegal by statute	yes	not explicitly
	Measures to prevent manipulation	various	no except for voluntary exchange actions
	Measures to control manipulation by government regulation	yes, the CFTC	generally no
	Prosecution of manipulators	yes	no

Table 5.1: Comparison of futures regulation in the US and the UK

functions they serve, etc. The implication of these features of futures markets for futures regulation is that aspects of market failures in futures markets may be different from those arising in other markets, and that therefore, futures regulation may merit special consideration in financial regulation. It follows from the previous sections, that it is obviously inappropriate that futures manipulation, a special form of monopolisation in futures markets, is absent from futures regulation in the UK.

Another major concern is that whether the regulatory system in the UK, which relies more on self-regulation and less on statute compared to the US futures regulation, is effective. There has been substantial debate in the UK about the structure of regulatory institutions and in particular about the role of self-regulation. However, our view is that the effectiveness of regulation is determined more by the way and measures to deal with potential market failures than by institutional structure. In fact, a blend of statutory and self-regulation on futures regulation is by no mean exceptional in the UK, and the advantage of the mixed regulatory system is that it is more flexible than a purely statutory regulatory system while is more effective than a purely self-regulated system. It is difficult to judge which proportion of this mixture is optimal in practice, and this may vary across countries and reflect the complexity of a particular national financial system. But in comparison to US futures self-regulation, it may be reasonable to be suspicious of the effectiveness of the UK self-regulation, in which the SIB has no substantial measures to monitor the SROs except the rule to oversee SROs in order to make sure the SIB's continued satisfaction of recognised requirements. Moreover, the SIB's power to sanction a particular SRO is limited to withdrawal of its authorisation, but withdrawal of recognition is too draconian a power to be routinely exercised. While in the US, the CFTC maintains continuous surveillance program to oversee the SRO specific surveillance program, and the Division of Trading and Markets conducts periodic reviews of a SRO's programs and work product.

Regulation is not a free good, an evaluation of any regulatory system involves cost-benefit analysis. The optimal regulation must be cost-effective, however, both the benefits

from correcting potential market failures and the costs of regulation are not all tangible and quantitatively measurable. The principle may be that, in considering the costs, regulation should be imposed only when significant market failures are expected (Edwards and Edwards 1984). The costs exist in several kinds and forms, and can be classified into five categories: direct resources costs; costs of compliance, costs from possibly diverting business to other countries; costs from reduced competition; and costs from stifling financial innovation. In comparison with the traditional method of regulation in the UK, the FSAct and the current regulatory system have been criticised as ignoring or giving insufficient consideration to the costs, hence the financial services industry tends to be over-regulated (Goodhart 1988). However, in comparison to UK futures regulation, it may be true that the US futures regulatory system may be more costly than the UK counterpart. The separated regulatory model certainly increases the direct resources costs and compliance costs of the regulated, and the CFTC's contract approval process has been suspected to reduce either static or dynamic efficiency (see Anderson 1981, Easterbrook 1986, etc.). It is hard to assess whether the benefits from wider objectives of futures regulation, the relatively more effective regulation, and larger volume of futures business can make up for the costs, we are therefore unable to conclude that the US regulatory system is more cost-effective. Both regulatory systems face future reforms, not only because of the inefficiency of the regulatory systems themselves, but also because of the potential challenges from the development of derivatives markets. However, our emphasis of discussion is the UK futures regulatory reform by using the US futures regulation as a mirror, since US regulation has evolved more than half a century.

### **5.3.3 How cost-effective futures regulation may be achieved in the UK**

The financial services regulation in the UK, as discussed previously, has been experiencing radical reforms. The “two-tier” regulatory and self-regulatory system established by the FSAct in 1986 is moving to a new regulatory system under a single, all embracing

ing regulator, the Financial Services Authority. The FSA puts together nine regulatory organisations,<sup>40</sup> and ultimately (expected to be late 1999) takes full responsibility for supervising banks (already in the first half of 1998), building societies, insurance companies, fund managers and investment advisors. The new regulatory system will enhance regulatory co-operation among various financial sectors, reduce certain amount of inefficiency, competitive inequality, inconsistency and duplications of efforts, but it is not clear at this stage whether this new system is more effective than the existing one. This depends on the powers given to it by statute and in which way it regulates financial markets. However, it may be reasonable to doubt the effectiveness of the regulatory system, since it does not appear to respond to concern about the very different objectives of regulation for different financial sectors.<sup>41</sup> For example, futures regulation does not appear to be a special concern under the new regulatory regime. More effective futures regulation in the UK may hinge on, as yet unseen, modifications of the FSAct.

### **Statutory prohibition of futures manipulation**

As indicated in previous section, the FSAct does not appear to address specifically futures manipulation, the important futures market failure evidenced in the US. The FSAct should be amended or be legally interpreted with the purpose of making explicit that futures manipulation is illegal, and a specific body should be empowered to prevent and control manipulation. This organisation will certainly be the Financial Services Authority. However, a more difficult problem remained is how to achieve this objective efficiently. There have been three approaches to deal with manipulation: *ex ante* prevention; *ex post* prosecution and halting suspected manipulation in process. The third

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<sup>40</sup>They are Building Societies Commission (BSC), Friendly Societies Commission (FSC), Insurance Directorate (ID) of the Department of Trade and Industry, Investment Management Regulatory Organisation (IMRO), Personal Investment Authority (PIA), Registry of Friendly Society (RFS), Securities and Futures Authority (SFA), Securities and Investment Board, and Supervision and Surveillance Division (S&S) of the Bank of England.

<sup>41</sup>A similar argument was also made by Goodhart *et al.* (1998, p.153). They stated: "[A] single regulator might not have a clear focus on the objectives and rationale of regulation, and might not make the necessary differentiations between different types of institution."

method (measures in the US include additional margin requirements, trading for liquidation only and other emergency measures etc.) is the least costly. However, its rationale has not been understood academically. Our dynamic game (Chapter 3) provides a justification for this set of emergency measures against manipulation. Although it is not clear whether an increase of this type of exogenous uncertainty will reduce the frequency of manipulation, the harmfulness of a manipulation will be greatly lessened. However, timely and accurate identification of manipulation is difficult, and excessive reliance on this method may jeopardise the proper functioning of a futures market. US experience suggests that *ex post* prosecution of manipulation has not been a successful way to deter manipulation, manipulation was even argued as unprosecutable crime (Markham 1991). This is largely because of the need to prove intentionality. The US regulatory regime has therefore put more emphasis on *ex ante* prevention of manipulation (measures in the US include contract approval by the CFTC, specific rules imposed by the CFTC on exchanges, the large trader reporting system, etc.), on the encouragement of civil actions against manipulation.

Our theoretical analyses (Chapter 2 and 3) suggest that, the key to a successful manipulation is the ability of a manipulator to obtain a large futures position in relation to the deliverable supply, therefore, effective prevention of manipulation is necessarily linked to the restriction of traders' conducts, the modification of terms of contracts and the monitoring of manipulatory potential. Modification of terms of contracts aims at increasing the ability of futures market to turn cash commodities into deliverable supply, which may include broadening of deliverable supply and extension of delivery points. Modification of terms of contracts in these ways will certainly make a futures 'corner' difficult, but may also reduce hedging effectiveness. Since under these circumstances, it is harder for a hedger to hedge against specific risk against the exact quality of the underlying assets or delivery point. Monitoring of manipulatory potential requires regulatory authorities to assess the size of client positions. The US experience on this aspect shows that the large trader reporting system has been successful in achieving this goal.

There is no client position reporting on statutory basis in the UK.<sup>42</sup> It is beneficial for the Financial Services Authority to establish a similar large trader reporting system as the US model on statutory basis. The CFTC large trader reporting system requires each clients, either foreign or domestic, who holds controls or has a financial interest in an open futures position which equals or exceeds the fixed reporting level for that particular commodity (reporting position) must file with the CFTC until his position declines below the reporting level. This information is subsequently released by the CFTC in aggregated form in the weekly Commitments of Traders in Futures (CTF) reports.<sup>43</sup>

In fact, it may be very difficult and maybe infeasible to extend the reporting to positions in cash markets and OTC markets which involves the issue of what constitutes relevant positions (for details, see Gilbert 1996, p.15), and also it is conceivable that such a strengthened system would be very expensive in terms of both direct costs and compliance costs, as well as the costs from possible reduction of liquidity resulting from the potential discouragement of large traders' trading and chasing business abroad. Therefore, it is doubtful whether the current system is effective in identifying all manipulative potential in practice. Even if so, and even if a relevant organisation is empowered to control manipulation when manipulation is in the course, such as the CFTC in the US, but not the SIB or FSA currently in the UK, one might still doubt whether the relevant regulatory body can take appropriate actions to control manipulation timely, because of the conflict of interests problem and also the rent-seeking behaviour. At the same time, the automatic measures, such as position limits, price limits, circuit breakers, have enormous side effects.<sup>44</sup>

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<sup>42</sup>There has been a voluntary reporting system (around 95% of all large positions are currently reported) on the LME where by brokers report client ownership of large positions, but there is currently no reporting of client positions on the LIFFE markets (Gilbert 1996, p.14).

<sup>43</sup>However, there are some serious limitations in the existing reporting system. First, it does not include the reporting of cash positions. Client cash positions can be very important to corner a market. Second, it is confined to on-exchange positions. Traders who wish to hide their positions can do so via OTC transactions, although many of these will subsequently translate into exchange transactions as the writers of the OTC positions offset their positions. Finally, it should but not currently include deltaed options positions with futures, since the two are nearly equivalent.

<sup>44</sup>For a discussion on these aspects, see Brennan, M. (1986), A Theory of Price Limits in Futures

Alternatively, it may be feasible and cost-efficient to construct a new anti-manipulation framework which combines the client position reporting system with a more rigorous *ex post* prosecution methodology and certain amount of emergency anti-manipulation fire-powers. Under this framework, the client position reporting system only serves two purposes: to provide necessary information for successful *ex post* prosecution; to allow other traders to be aware of manipulation possibility from an increase in the position concentration, thus they will manage their positions accordingly (for a detailed discussion, see Gilbert 1996, p.16). This will make manipulation more difficult and riskier for the manipulator. The effectiveness of this framework will mainly hinge on successful prosecution deterrence, which necessarily involves legal reforms: one of these is to delete intent element from manipulation; another is to make offence penalties more harmful. Intentionality is, like in other crime prosecutions, a factor to determine penalties the offenders deserve, but not a determinant of the nature of crime. More importantly, it would be beneficial to realise that intentionality can be testable, as Pirrong suggested, by asking a different question “are there any nonmanipulative explanations for this conduct ?” (Pirrong 1994, p.994). Manipulation or manipulation attempt is an economic offence, it must have sound economic effects that other commercial activities do not have, including price effects, quantity effects, basis effects. These economic effects are highly reliable to be used to detect manipulation or manipulation attempts, they can be used to assign responsibility to a specific trader (traders) if each client positions and strategies have been properly recorded. However, the third element of this framework - the optimal amount of intervention by regulators or exchanges when a manipulation is suspected, is naturally difficult to be defined. The principle may be that, the firepower is legally created, but should be cautiously exercised. This proposed approach is much less costly than the US existing one. But it is more reliable, since manipulation is sometimes only detected *ex post* from its economic effects.

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Markets, *Journal of Financial Economics* 16, pp.213-233; Kyle, A. (1988), Trading Halts and Price Limits, *Review of Futures Markets* 7, pp.427-434; Ma, C., Rao, R., and Sear, R. (1989), Volatility, Price Resolution and the Effectiveness of Price Limits, *Journal of Financial Services Research* 3, pp.165-199.



## **Disciplining customers and extra-territorial extension of regulation**

In principle, UK financial services regulation covers all investment business in the UK. Therefore, a non-UK firm needs to be authorised under the FSAct for investment business carried on in the UK. This includes all business carried on from an UK office, even with non-UK customers. In addition, even if it does not have a UK office, a non-UK firm nonetheless needs to be authorised for investment business carried on from a non-UK office with customers or counterparties in the UK on a services basis unless the FSAct's overseas person exemption applies. The scope of the FSAct does not cover customers (including non-UK customers) who do not carry on investment business in the UK. This result is not surprising because the main concern of the FSAct is investor protection. However, it is inappropriate when broader objectives of financial regulation are considered. For example, in futures regulation a powerful customer may manipulate a market (Sumitomo, who manipulated the LME copper market, is an example), and can also cause concern in relation to systemic risk.

The CEA and CFTC in the US have the power of supervision and jurisdiction over both US and non-US customers. Specifically, every non-US person must become a customer of a FCM, and the FCM acts as an agent of that customer for the purpose of accepting delivery and services of any 'communication' (e.g., a summons, complains, order, request for information), issued by or on behalf of the CFTC to the non-US customer. Furthermore, if the futures positions carried by a customer (either US or non-US customer) exceed the CFTC or specific market reporting level, the FCM is required to furnish the identity of the customer to the CFTC or the applicable contract market. In particular, any customer with reportable positions must file with the CFTC on the CFTC 'form 40', which includes information about the identity of the customer, the identity of all FCMs through which it trades, and identity of persons who have a financial interests of 10% or more in the account of the customer. In addition, the customer must also maintain books and records showing all details concerning all futures positions and transactions and all positions and transactions in the underlying cash commodity or its

products or by-products. The CEA has jurisdictions over non-US persons who engage in transactions (including on US exchanges and non-US exchanges) with US persons. The FSAct currently in the UK neither disciplines customers, nor has extra-territorial jurisdiction power. The UK futures regulation may follow the US model of customer regulation and introduce the extra-territorial element into the FSAct. This is essential for futures regulation, although it may be not very important for other financial services regulation, because manipulation has been identified as a major form of market failures in futures markets, and there is no reason to believe that customers who lies outside SRO jurisdiction may have less tendency to manipulate a market. However, extra-territorial extension of regulatory power requires international regulatory co-operations, and the potential conflicts between regulators do not seem to be strong with respect to position reporting system.

### **Reviewing some measures on investor protection**

UK financial services regulation mainly followed the US path of securities regulation. As having been argued, the objectives and methods of regulating futures markets have been significantly different from those of securities regulation in the US. There are even huge differences on investor protection in these two sets of markets. Securities regulation requires more extensive disclosure, prohibits insider trading, establishes a suitability requirement, provides insurance against broker insolvency, and prohibits dual trading. However, these restrictions do not exist or just exist in the least extent in futures regulation. The comparison of UK futures regulation with the US counterpart shows that significant differences on investor protection exist, especially with regard to suitability requirement, prohibition of churning, and investment insurance, which exists in the UK but not in the US futures regulation. These rules are worth reviewing. The issue is what justifies these specific investor protection rules, are they cost-effective in futures regulation? Our concern is that the nature of futures trading would make these rules unenforceable, unnecessary, and expensive, which may affect the liquidity of markets and

the competitiveness of firms.

Suitability is a securities law concept where brokers are required to 'know their customers'. Under this rule, brokers are required to recommend to their customers only the securities transactions which the brokers reasonably believe are 'suitable' in light of customers' financial position and investment goals. This rule is imposed by exchanges, by the National Association of Securities Dealers, and in certain cases, by the SEC in the US. It was introduced into the SFA rules in the UK. However, it is largely inapplicable in futures trading. Suitability in futures trading depends on both the investor's wealth and reasons for undertaking a futures transaction. A hedging transaction is easier to be justified than a speculation, but it is a very difficult task to justify a speculative transaction which involves the evidence that the customer has the financial ability to absorb any losses which he may incur. Additionally, the difficulty of imposing the suitability rule arises from the fact that it is very hard for the broker himself to assess the risk of a futures transaction involved. The only way for a transaction to be believed to be 'suitable' by a broker may be to require huge amount of disclosures from the customer, sound researches on the relevant markets and underlying assets, but this will involve large costs. The prohibition of churning rule provides that a firm must not make a personal recommendation to a private customer to deal, or arrange a deal in the exercise of discretion for any customer, if the dealing would reasonably be regarded as too frequent in the circumstances. What is reasonable is not clear here, and more important, the application of this rule is also difficult because futures markets are often highly volatile, implying a possible justification of a very active investment policy. Accordingly, the rate of turnover of a portfolio investing significantly in futures may quite legitimately be much higher than one would expect a portfolio investing solely in securities markets. Therefore it may be impossible to detect churning accurately in practice. Although it is impossible to enforce the rules of suitability and prohibition of churning in futures markets, they impose significant costs on brokers, and importantly, they may affect the cost functions of different brokers (it will cost law-abiding firms more than others), and therefore, the

competitiveness of these firms in futures markets.

Investor protection in the UK was enhanced by the establishment of a compensation fund under Section 54 of the FSAct which provides a final ‘safety net’ for purposes of compensating investors who lose their funds as a result of an authorised business being unable to satisfy their civil liabilities to their clients incurred in connection with investment business. This is a supplement to the segregation of customer funds. However, the importance of the compensation fund is doubtful if segregation of client funds is properly enforced. It is even less useful in futures markets because relatively shorter terms of contracts and marking to market practice would make conversion of customer funds more difficult than in securities markets. Furthermore, the compensation fund is very costly. The costs comprise of two parts: firstly, the management and enforcement costs; and secondly, the costs of building the fund. Both parts of costs are eventually levied on customers, although the latter is not a resource cost, and it will be either distributed to claimants, or return in due course to those subscribing. The practices of futures trading makes the insurance program in futures markets less important, and the costs may discourage investors coming into the markets, because the demand elasticity of financial services is evidenced to be high. The argument that the insurance scheme may increase investors’ confidence in futures markets, and therefore, possibly liquidity of futures markets, may not be valid here.

#### **5.3.4 The future of futures regulation**

Futures markets and other financial markets have been experiencing rapid changes over the last decade, including rapid market and product innovations, rapidly increased trading volume (both on-exchange trading and OTC trading), much wider range of products, greater accessibility to either domestic or foreign markets, etc. Such changes clearly present substantial opportunities for the industry as well as for investors. But they also pose challenges both for the industry and regulators. From the industry perspective, the challenges are primarily competitive, while the implications for the regulators are

far dramatic, which may involve greater co-ordination of regulatory efforts, regulatory convergence of different markets, changes in regulatory approach. Rapid changes in futures markets as well as other financial markets are mainly brought by the advancement of technology and increased globalisation. These changes affect both the scope and the depth of products and market places. They fostered a huge variety of products and services, while the markets were shrunk in terms of accessibility and simultaneously market depth was expanded in terms of available offerings. In futures markets, one of the best illustrations of these has been the growth of electronic trading systems as an alternative to traditional exchange/auction or dealer-based trading systems.<sup>45</sup> Many of these systems permit investors to deal directly with each other at lower costs than previous trading systems. Moreover, internet is introduced into the markets. In June 1997, the CFTC permitted futures brokers to make use of electronic media in communicating with their customers (to deliver monthly statements, trade confirmations and other account statements solely by electronic media to their customers). This step should increase the timeliness of information flows and benefit brokers and customers by enabling them to reduce their administrative costs. Technology and globalisation will inevitably bring the following results to futures markets:

Firstly, there will be greater needs of regulatory convergence, both domestically and internationally. Innovation and technology have had one obvious effect: as it becomes harder and harder to draw lines among the players and services in financial markets, there will have to be greater regulatory co-ordination of regulatory efforts and co-operation among regulators. This requires: (i) each agency has access to the information necessary to fulfil its regulatory objectives; (ii) market participants subject to multiple regulations are not so overburdened that they become competitively disadvantaged; (iii) financial products, services and markets delivering similar benefits and risks can be subject to

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<sup>45</sup>From 1989 to 1996, volume on electronic trading systems used by futures exchanges was more than doubled, rising from 7 percent of the world's trading volume to 8 percent. The number of exchanges worldwide that use electronic systems in varying degrees to trade futures and options increased from eight in 1990 to almost forty in 1997. See Sarker, A. and Tozzi, M. (1998), *Current Issues in Economics and Finance*, Vol. 4, No. 1. Federal Reserve Bank of New York.

equivalent regulation, so that economic competition rather than jurisdictional barriers or differences in supervision can determine which products, services and markets succeed in the marketplace. The first two requirements may be better fulfilled by establishing unitary regulatory organisation covering all financial markets, products and participants, such as the UK's FSA. However, this does not exclude other possibilities of regulatory co-operations. The convergence of regulation does not imply a uniform regulatory structure for all financial markets, as there are significant distinctions in the precise rationale for regulating different markets. This therefore requires the law should be modified to reflect distinctions of market failures between different financial markets. The last requirement urges, particularly in futures regulation, to extend the existing futures regulation to whole derivatives markets, whether relating to financial assets or obligations, foreign exchange, or agricultural or mineral commodities, whether forward contracts or other credit-risk-determined instruments (interest rate and currency swaps, for example). This remains a tough task for the futures regulatory reform in both the US and the UK. Each regulator, however, has currently primary and pervasive control over entities within its jurisdiction, international co-operation presents more difficulties. We have been seeing the importance and steps of information sharing and regulatory convergence among international futures regulators. In the 1970s regulators concentrated on addressing fraudulent activities occurring on a cross-border basis by entering bilateral memoranda of understanding. Recent extraterritorial events, such as the failure of Barings and the Sumitomo copper manipulation, prompted more co-operations on multilateral basis, and produced the Declaration on Co-operation and Supervision of 1996,<sup>46</sup> and the London Communiqué of 1996.<sup>47</sup> But it is debatable to what extent international financial regulation should converge. Should

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<sup>46</sup>Barings event gave birth to the *March 1996 Declaration on Co-operation and Supervision*, which has been signed by 20 regulators, and its companion agreement among self-regulatory organisations, which has been executed by 62 exchanges and clearing houses.

<sup>47</sup>Following the Sumitomo event, the CFTC, SIB and the Ministry of International Trade and Industry of Japan co-sponsored the International Regulators Conference in London in November 1996, which focused on the special problems that physical delivery markets pose for contract design, market surveillance and international information sharing. The 17 participating regulators issued a Communiqué agreeing on certain basic principles of regulation.

a single international regulator for global financial markets be desirable? We doubt that the single regulator will be realised within any relevant time frame. And additionally, the existence of multiple regulators having different perspectives and regulatory philosophies may be advantageous. Whatever it may be argued, however, enhanced international co-operation is highly possible and desirable, and this is the appropriate direction for future efforts. This implies that there will be a number of international standards or accepted parameters of futures regulation for example, the approved generic risk disclosure in the US and the UK, the proposed client position reporting system in the UK, etc.

Secondly, the traditional regulatory philosophy needs to be changed. The faster pace of market and product innovations requires more flexible regulation, and an increased emphasis by regulators should be on objective oriented regulation rather than on the regulatory approach dictating specific process that the regulated must follow. This is a serious challenge facing futures regulators as well as other financial regulators. The difficulty lies in how to balance between the effective regulation and the flexibility that allows the market for services and the market for providers of services to continue to evolve. Moreover, the market and product innovations themselves make the markets and products particularly complex, which may pose additional difficulty for regulators. Such a balance is critically important but very hard to attain. In order to realise this balance, it is essential for regulators to: (i) understand the fundamental economic theory of a market or market participants' behaviors, and how the behaviour of markets or participants are interacted; (ii) anticipate how a rule or an instrument of regulation affects long-run behaviors of markets or market participants; (iii) permit the regulated enough flexibility to comply with the regulation and to encourage best practice of the regulated. For example, the traditional funds-based approach of capital requirements does not meet very well the need to estimate accurately how much capital is required to protect the public and wider financial system from a firm's failure in today's market environment, where a firm's risk profiles are dramatically changed due to vast involvement in sophisticated derivatives trading. Value-at-Risk Models (VaR), which have been firms'

internal risk management tool, have been used or proposed to be used as regulatory purposes in replacement of traditional capital requirement. This VaR approach, based on more sophisticated statistical risk management methodologies and modern option and portfolio theory, calculates a firm's capital requirement more flexible to reflect the size, scale, strategies of the firm, and creates incentives for a firm to seek better risk management policy. However, the Value-at-Risk Models employed by firms are different, and it is therefore possible for different firms' models to produce significantly different Value-at-Risk numbers for the same portfolio. In order for this approach to be effective, regulators have to impose a number of key parameters, such as the observation period over which model relationships are calculated, the confidence level which is applied, the acceptability of correlation within or among product types, etc.

## 5.4 Summary and Conclusions

The rationale for futures regulation is to correct market failures or market imperfections in futures markets, some of which are different from other financial sectors. These differences warrant special consideration for the regulation of futures markets. Futures manipulation is one of the most serious market failures, which is essentially a special form of temporal monopoly of supply in futures markets. Susceptibility of manipulation in futures markets suggests futures manipulation should be a special concern in designing futures regulatory framework. Other types of market failures which exist in other financial markets, such as externalities, natural monopoly, and information asymmetry, still present in futures markets, but are more or less different from other financial sectors.

Self-regulatory organisations in futures markets, including futures exchanges, clearing houses, and industry associations, such as the NFA in the US, the SFA in the UK, may not have sufficient incentives to correct all types of market failures. Since under some circumstances, the private costs and benefits of self-regulatory organisations in correcting market failures are obviously divergent from social costs and benefits, for example, in



the case of futures manipulation. Therefore, external regulation in futures markets is justified.

Approaches to regulating futures markets are different in the US and the UK. These differences exist both in the organisational structure and in the aspects of specific regulation. Futures regulation in the US has been separated from regulating other financial markets, while financial services markets in the UK are regulated under the single statute (FSAct) and single body (FSA). Futures manipulation has been one of the greatest concerns in futures regulation in the US since the start of formal Federal futures regulation in 1920s, while it does not appear to have been a significant objective of futures regulation in the UK. The UK's purpose to regulate financial services markets is mainly investor protection, and this approach seems to have followed the US model of securities regulation. Even with regard to investor protection, futures markets are different from those in securities markets since futures markets have their own characteristics. Some measures of investor protection in the UK, absent in the US futures regulation, such as the suitability requirement, prohibition of churning, and investor compensation scheme, appear to have little value and to be unenforceable, while adding significant costs to investors, and probably distorting competitiveness among dealer/brokers.

It is necessary to carry out regulatory reforms in order to establish a possible cost-effective futures regulatory system in the UK. These require:

- The FSAct should be modified or legally interpreted to make futures manipulation illegal explicitly, and some provisions should be established in order for the Financial Services Authority to fight against manipulation - these may include introducing the large trader reporting system into UK and endowing the FSA with anti-manipulation firepowers.
- Futures regulation should be extended extra-territorially, as did in the US.
- Measures of investor protection should be reviewed, and some of them, in particular, the suitability rule, prohibition of churning, and investor insurance which are

extremely expensive, less valuable and unenforceable in futures markets, should be removed.

Futures regulation in the US requires urgent enforcement reform as well, especially in the case of manipulation. The element of intentionality should only be a factor in considering the seriousness of the crime involved but not in determining the nature of crime. Nevertheless, manipulation is a form of economic offences, and intent should be economically testable. At the same time, both regulatory systems are required to be reformed to meet the current and potential challenges in the futures markets, including rapid market and product innovations, rapidly increased trading volume, and globalisation. These imply the requirements of greater co-ordination of regulatory efforts both domestically and internationally, regulatory convergence of different markets, and changes in regulatory approach. The recent UK merger of financial regulation into one single body – the FSA may enhance the efficiency of co-ordination, but domestic regulatory co-ordination in the US appears likely to be more problematic in the future reform.

# Appendix:

## Futures regulatory frameworks in the US and the UK

### 1. The US futures regulatory framework

**The Commodity Exchange Act and the Commodity Futures Trading Commission Act** The first legislation on future trading in the United States dated back to the adoption of the Grain Futures Act of 1922 (GFA). The GFA established a licensing system that requires commodity exchanges to be designated by the Federal Government (Department of Agriculture) as “contract markets”, and sought to prevent price manipulation by requiring exchanges to act to prevent such conduct. Although the GFA was subsequently replaced by the Commodity Exchange Act of 1936 (CEA) which became the principal regulatory legislation of futures trading in the United States until 1974, it nevertheless formed the core of the regulatory framework. The “fundamental purpose” of the CEA was “to ensure fair practice and honest dealing on commodity exchanges and to provide some measure of control over these forms of speculative activity which so often disrupts the markets to the damage of producers and consumers and even the exchanges themselves”.<sup>48</sup>

Since futures trading played an increasingly important role in the pricing and marketing of US commodities, and futures markets extended to coffee, sugar, cocoa, lumber, plywood, precious metals, and markets in a number of foreign currencies, home mortgages, government securities, etc., where many of these markets were not covered by the CEA. Therefore, in 1974, the new legislation – the Commodity Futures Trading Commission Act (CFTCAct) was enacted. This legislation created an independent five-member regulatory commission - the Commodity Futures Trading Commission (CFTC), which was endowed with increased power for rule making and enforcement, and extended scope of jurisdiction over options and futures contracts.

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<sup>48</sup>U.S. Congress, House, Amend Grain Futures Act, 73d Cong., 2d Sess., 1934, H.R.Rept. 1673. p.1.

**The Commodity Futures Trading Commission** The CFTC was established as an independent regulatory agency, comprising a chairman and four commissioners appointed by the President, with the advice and consent of the Senate. The purpose of the agency is to ensure the financial and market integrity of the US futures markets, and to protect market participants against manipulation, abusive trade practices, and fraud. Its responsibilities include: reviewing the terms and conditions of proposed new futures and options contracts; conducting daily market surveillance and, in an emergency, ordering an exchange to take specific action or to restore orderliness in any futures contract that is being traded; protecting customers by requiring companies and individuals who handle customer funds or give advice to apply for registration through the National Futures Association (NFA), and by requiring registrants to disclose market risks and past performance to prospective customers; monitoring registrant supervision systems, internal controls and sales practice compliance programs. The CFTC has five major operating units: the Division of Economic Analysis, whose responsibility is to ensure that markets remain competitive and responsive to underlying supply and demand factors by detecting and protecting against price manipulation; the Division of Trading and Markets, which oversees the compliance activities of the commodity exchanges and the NFA; the Division of Enforcement, which is responsible for investigating and prosecuting alleged violations of the CFTC regulations; and the Office of the General Counsel, the Office of the Executive Director.

**Self-regulatory Organisations** As a matter of policy, the CFTC has delegated much of its direct regulatory responsibilities to self-regulatory organisations which are subject to the CFTC's oversight. Self-regulation in US futures markets is carried out by three types of self-regulatory organisations: futures exchanges, clearing houses and the NFA. Organised futures exchanges are membership organisations, and impose regulation on their members. Futures exchanges as self-regulatory organisations originated a century ago. They establish rules of conduct that ensure that futures trading takes place in a

manner that promotes interests of memberships as a whole. Exchange members comprising different commercial groups have diverse interests and motivations, and the rules and policies adopted by exchanges, are therefore expected to reflect these characteristics. Under the CFTCA Act, a futures exchange will gain CFTC designation only if it demonstrates that it can perform certain self-regulatory functions in pursuit of a wider public interest, and the exchange is required to demonstrate that futures contracts are not liable to manipulation.

Futures clearing associations in the United States are also membership organisations and are almost all affiliated to the specific exchanges. They clear futures trades made on those exchanges, although their organisational structures may differ.<sup>49</sup> Clearing associations set minimum requirements for their members to maintain financial integrity of all clearing members which are, in turn, important in determining margin requirements for non-clearing members. Unlike futures exchanges, no specific statutory requirements are imposed on clearing associations.

Because the reach of futures exchange or clearing association self-regulation is limited to its members, non-member futures professionals may escape scrutiny. The CFTC created the National Futures Association in 1981, which is mainly responsible for these kinds of regulatory responsibilities. As a self-regulatory organisation authorised by the CFTC, the NFA requires firms and individuals who conduct futures-related business with the public to apply for registration and membership with the NFA. The NFA has extensive rules governing the conduct of its categorised members: Futures Commission Merchants (FCMs), Introducing Brokers (IBs), Commodity Pool Operators (CPOs), Commodity Trading Advisors (CTAs) and Associated Persons (APs). The NFA sets standards and conducts proficiency tests for all categories of members. The NFA's rules for members include the conduct of sales and marketing, treatment of customer funds, execution of customers orders, and the adequacy of record keeping and reporting. The CEA further

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<sup>49</sup>For a discussion of clearing associations, see Edwards, F. R. (1984), the Clearing Association in Futures Markets: Guarantor and Regulator, in Anderson ed., *The Industrial Organisation of Futures Markets*, Chapter 7, pp.225-54.

stipulates that no NFA member may do business with any firm or individual who is not an NFA member. To avoid overlap regulatory organisation, each market professional has a primary self-regulatory organisation, referred as a 'designated self-regulatory organisation' (DSRO). NFA is the DSRO for CTAs and CPOs and for FCMs and IBs that are not member firms of a contract market. But all market professionals except Floor Brokers (FBs) and Floor Traders (FTs) must be members of the NFA. In essence, the NFA assumes some regulatory responsibilities of the CFTC, and shows a significant increased responsibility in regard to investor protection matters.<sup>50</sup>

Discussion of the US regulatory regime naturally extends to the Securities and Exchange Commission (SEC), another federal regulatory agency which has jurisdiction over the trading of securities and investment contracts in interstate commerce, including the operations of investment management companies organised under the laws of the US or a US state, and the US activities of foreign investment management companies, since in some futures-related transactions SEC regulations also may apply. This gives rise to conflicts and disputes in jurisdiction between the CFTC and the SEC. The major conflicts arise from the CFTC's exclusive jurisdiction on certain financial instrument options and stock index futures contracts. Although the CFTC and the SEC reached an accord in 1982, in which the CFTC dropped its claim to exclusive jurisdiction over foreign currency and debt securities options and its rights to a few specific futures contracts in exchange for SEC recognition of CFTC authority over derivative contracts not exempted by the accord, the two agencies clashed again soon after the accord (Kane 1984, pp.378-80). Futures regulation also relates to the Federal Reserve Board ("Fed") in relation to margin requirements on futures contracts. The CFTC has no authority to review futures contract margin rules employed by exchanges except for the power to establish temporary emergency margin levels. Instead, the "Fed" is empowered under securities laws as the margin authority. The "Fed" has asserted, but has not attempted to exercise authority to

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<sup>50</sup>NFA began operation with memberships in 1982, started to register IBs and APs in 1983, and extended its cover to the other member registration in 1984. In 1986, the NFA was authorised to deny, revoke, condition, restrict and suspend registrations for all member categories.

prescribe margin requirements for futures on stock indices. Potential conflicts on margin rules in futures markets may arise, but have not been tested. Common practice is that exchanges inform the “Fed” of their intended margin requirements, and the “Fed” in turn has taken the view the margin levels in futures markets appear adequate (Anderson 1986, p.45).

## 2. The futures regulatory framework in the UK

**The Financial Services Act** The legal framework for the regulation of futures markets as well as other investment business in the UK was established with the passage of the Financial Services Act (FSAct) in 1986. The scope of the FSAct is enormous, covering the activities of all securities dealers, brokers, pension funds, investment and unit trusts, futures and options traders, investment managers and financial advisers as well as some activities carried on by banks and life insurance companies. The Act also establishes criteria for the recognition of investment exchanges and clearing houses. Prior to the FSAct, the regulation of futures markets was informal, and was typically based on self-regulation of exchanges. Regulation of some investment business was covered in certain aspects by the Prevention of Frauds Investments Act 1958 (PFI), the Companies Acts and the Thefts Acts 1968 and 1978, but the PFI was not generally applicable to futures trading.<sup>51</sup>

The FSAct followed the publication of Gower Report, which in turn was prompted by the financial failure of a number of financial businesses. The concern of the Gower Report was investor protection, and the objective of the FSAct was to correct deficiencies in existing legislation relating to investor protection. The regulatory tasks set by the FSAct are authorisation of investment business, rule making and enforcement. Under the FSAct institutions undertaking investment business in the UK require authorisation

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<sup>51</sup>S13 of the Prevention of Frauds Investment Act 1958 provided that inducing or attempting to induce another person to enter into an agreement for the acquisition or disposal of securities by means of misleading statements was a criminal offence subject to a term of seven years' imprisonment, but futures contracts were clearly not “securities” for the purposes of this section.

or exemption. Firms will be authorised only if they satisfy various criteria including: run and controlled by persons 'fit and proper'; provision of 'sufficient' capital; separation of their own funds from those of clients; compliance with rules regarding the way in which business is conducted. Many institutions are required to be covered through the Investor Compensation Schemes.

Powers were vested by the FSAct in the Secretary of State (the relevant department being originally the DTI, and subsequently the Treasury), some of which powers could be delegated to a 'designated agency', the Securities and Investment Board (SIB). In turn, the SIB has recognised a number of self-regulating organisations (SROs), exchanges and clearing houses<sup>52</sup> which carry out much of the day-to-day regulation of firms involved in investment business.

**The Securities and Investment Board (SIB) and The Financial Services Authority (FSA)** Under the terms of the FSAct, regulatory powers was delegated to the Securities and Investment Board, which is a private body financed by charges levied on the investment industry. The main purpose of the SIB was not to directly regulate individual firms but rather to monitor self-regulatory organisations (SROs). The SIB's main role was that of certifying that the SROs' rule books are, at a minimum, consistent with the aims of the Act and that arrangements for monitoring compliance with those rule books were adequate. The SIB established ten principles and a set of core rules on conduct of business,<sup>53</sup> which form the essential spine of the UK regulatory system for the conduct of investment business. The rulebooks of SROs were required to be consistent with these essential principles. It was intended that, the authorisation criteria and rules

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<sup>52</sup>SROs in the UK are currently Investment Management Regulatory Organisation (IMRO), Personal Investment Authority (PIO) and Securities and Futures Authority (SFA); Six RIEs are the London Stock Exchange (LSE), the London Metal Exchange (LME), the London International Financial Futures Exchange (LIFFE), International Petroleum Exchange (IPE), Tradepoint Financial Network and the Options Markets (OM London Ltd). The RCHs are mainly the London Clearing House Ltd (LCH) and the CrestCo.

<sup>53</sup>The Securities and Investment Board (1991), *Principles and Core Rules for the Conduct of Investment Business*, January 1991.



directly adopted by the SIB should become benchmarks or more precisely minima models to which the rules of SROs would have to conform. In October 1997, the SIB was renamed to the Financial Services Authority (FSA), the single financial regulator in the UK. The FSA not only is responsible for supervising banks, listed money market institutions and related clearing houses which were originally part of responsibility with the Bank of England, but also acquire the regulatory and registration functions currently exercised by the SROs, the DTI Insurance Directorate, the Building Societies Commission, the Friendly Societies Commission, and the Registry of Friendly Societies. The FSA will not assume the second part of responsibilities until the enactment of a proposed financial regulatory reform bill (expected to be late 1999). Before that, the other constituent bodies will continue to have legal responsibility for regulating their firms under the original statutory or contractual arrangements. We therefore sometimes still refer to the original names in the description of the UK futures regulation in the text, such as the SIB, SFA, etc.

**Securities and Futures Authority (SFA), Recognised Investment Exchanges (RIEs) and Recognised Clearing Houses (RCHs)** Under the terms of the FSAct all institutions undertaking investment business were to be monitored by one of the SROs, or the SIB. The principal regulator of futures business was the Securities and Futures Authority.<sup>54</sup> Although a number of exclusions under the FSAct exist, there is none which is of general relevance to an UK-based futures dealers, brokers, managers or advisors. Therefore, authorisation is almost certainly required, and the SIB had the sanction of refusing to recognise any SRO, including the SFA. The SFA was a private body funded by, and generally run by practitioners. Although it did not have any direct powers under the Act except to sanction members who do not comply with its rules and ultimately to expel them, any futures business that is designated as an investment business under the

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<sup>54</sup>The original SRO for futures business was the Association of Futures Brokers and Dealers (AFBD) which was founded in 1984, and a merger of AFBD and The Securities Association (TSA) formed the SFA.

terms of the FSAct has to be a member of SFA or directly authorised by the SIB.

The SFA developed its rulebook, including principles and the conduct of business (COB) rules. A number of rules were specifically aimed at 'derivatives' or 'contingent liability' transactions, including rules on risk warnings, customer agreements, suitability, dealing rules, client money, information disclosure, unsolicited calls, advertising, etc. The extent of regulation differs between on and off-exchange transactions, private and non-private customers, margined and non-margined contracts, and hedging and speculation.

The SFA in the UK plays an analogous role to that of the NFA in the US: both are the self-regulatory organisations in the two respective countries, but the legal status of these two SROs is different. The NFA is explicitly recognised by the Statute (CFTCAct), while the SFA was designated by the SIB. Additionally, membership with the NFA is required for most categories of futures business, but the SFA did not have such a monopoly power for membership registration in futures related business.<sup>55</sup>

Because futures transactions are deemed to be investment business, a futures exchange has to be recognised under the FSAct Schedule 4. The main requirements include ensuring that the exchange has sufficient financial resources for proper performance of its function; the exchange's affairs are conducted in an orderly manner in order to offer proper protection to its investors; the exchange has adequate arrangements and resources for the effective monitoring and enforcement of compliance with its rules and any clearing arrangements made by it and rules of complaint hearing. An additional requirement, default rule, is added in order for an exchange to be recognised by the Companies Act 1989 Schedule 21. An argument against the emphasis on investor protection is that London futures markets are traditionally dominated by professional interests, unlike the active participation of individual speculators in the US markets. Upon a closer analysis, this argument is not persuasive. The functions of futures markets are the same, and the markets themselves should not be different in nature, while recent developments in London

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<sup>55</sup>Some institutions can directly seek authorisation from the SIB, while some may be authorised to engage in futures business by the rule of main line of business.

markets show the intention of encouragement of small investors into the markets.

The London Clearing House Limited (LCH) is a major recognised clearing house in the UK which acts under the FSAct. Unlike the situation in the US, the LCH acts as an independent clearing house to clear contracts for several exchanges, including LIFFE, the LME, the IPE, and Tradepoint Financial Networks. To be a recognised clearing house, LCH must comply with Section 39 of the FSAct and the rules of the SIB. Its objectives are to provide a secure, efficient clearing service to its members and the London exchanges on which they trade, and to protect the integrity of those exchange markets by acting as central counterparty and guarantor. The LCH ownership was transferred from banks to the clearing membership in 1996. To be eligible for membership of the LCH, firms must have not only an exchange clearing membership or memberships, but also the regulatory authorisation appropriate both to their overall activities and to their function in the cleared markets.<sup>56</sup>

The Treasury has ultimate responsibility for the operation of the FSAct, for which it is answerable to the Parliament, although it delegated most of its functions to the SIB<sup>57</sup> (the FSA in the near future). The Treasury monitored whether the SIB meets the statutory requirements in relation to its qualifications as the delegated agency, the principles applicable to its rules and regulations, and ultimately has the power to assume all of the functions of the SIB. Futures regulation in the UK also involves other regulatory authorities, especially the Office of Fair Trading (OFT), the Serious Frauds Office (SFO), and Department of Trading and Industry (DTI). The OFT is responsible under statute for reviewing anti-competition practices in goods and services markets in the UK in general. In futures markets, this implies a continuous commitment by the OFT in reviewing anti-competitive effects in rules or arrangements of prospective or existing SROs, investment exchanges or clearing houses. The SFO is responsible for bringing prosecutions under the FSAct in the UK, but is usually limited to prosecuting cases which appear to the

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<sup>56</sup>London Clearing House, Market Protection, 1st edition, December 1996.

<sup>57</sup>However, the Treasury retained some functions. for example, the recognition of overseas investment exchanges.

Director to involve serious or complex cases, usually involve sums over £2 million. The DTI under the Companies Act 1985 has wide-ranging powers to investigate the affairs of the company concerned, however, in major cases of financial fraud, the first step is often the investigation by the DTI. Following the implementation of the European directives relating to investment services, responsibility for the supervision of certain European firms conducting investment business in the UK is shared with the relevant domestic, or 'Home State' regulators.

# Chapter 6

## Conclusions

Commodity futures markets have been evolving since the mid-nineteenth century in the United States, and manipulation has been one of major concern in the development of futures trading. However, the issues of whether manipulation is an equilibrium phenomenon and the nature and extent of the effects of manipulation are, at least as a matter of theory, still controversial. The rationale for futures (derivatives) regulation has therefore not been well understood. In response to these calls, this thesis has attempted to investigate, theoretically the vulnerability of a commodity futures market to manipulation and factors affecting this vulnerability, empirically the economic effects of futures manipulation, and explored the implications of these results for futures regulation. The central conclusion of this research is that, commodity futures manipulation can occur in equilibrium under rather weak conditions: the first is that the supply of physical deliverable assets is less than perfectly elastic; the second is that there exists asymmetric information in futures trading. The first condition prevails for most commodity markets and the latter condition essentially results from the attractive features of futures trading itself. This result is still robust in a dynamic setting even if other traders trade strategically, although manipulation may occur less frequently compared with the static model. More important, manipulation adversely affects the functioning of a futures market: it not only reduces the accuracy of price discovery of a futures market, but also discourages hedge-

ing. Therefore, we argued that manipulation should be one of major concerns in futures regulation. These results may be potentially extended to other derivatives markets.

In a simple Bayesian-Nash game developed in Chapter 2, we derived that the sufficient conditions for the existence and non-existence of futures manipulation strategies and identified the importance of informational asymmetry and its associated adverse selection problem in determining the susceptibility of a futures market to manipulation. Our analytical results demonstrated that manipulation affects the functioning of a futures market adversely. Manipulation distorts the relationship between futures price and the future cash price through its effects on traders' expectations, and futures price cannot be an unbiased estimate of the expected cash price anymore from the point view of other traders or market observers except the market makers. Typically, long manipulation increases the equilibrium futures price and discourages hedging activities. In Chapter 3, we moved further to examine the robustness of the results derived from the simple Bayesian-Nash game by extending the game setting to a dynamic context. We demonstrated that manipulation can still occur in equilibrium, but may occur less frequently, since other traders' learning process by observing some publicly available information may constrain the large trader's behavior to a certain extent. One interesting result from the introduction of the variable of exogenous market uncertainty into the dynamic system was that the large trader will behave less aggressively and the adverse effects of manipulation will be lessened, since the large trader has to take this risk into consideration when he chooses his trading strategies. This finding may provide justifications for certain anti-manipulation rules currently imposed by either exchanges or regulators, such as trading for liquidation only, trading halts, allowing shorts to default, etc.

This thesis also empirically examined the economic effects of the alleged Sumitomo copper manipulation on the LME, and the result supported our theoretical analysis. We found that the manipulation not only affected the relationships between futures price and the futures cash price through its effects on traders' expectations, but also influenced the basis and basis risk. These undermined the proper functioning of the LME copper

market. Additionally, we employed a simple VAR approach to investigate whether the alleged Sumitomo manipulation influenced the LME cash prices. We found that the actual LME prices were generally above the forecast prices during the period of alleged manipulation.

From our analytical results and empirical analysis, manipulation has important policy implications for futures regulation, i.e., manipulation should be one of the major concerns in regulating futures trading. Our policy recommendations for regulation against futures manipulation include, statutory prohibition of manipulation and a three-element anti-manipulation framework: a large client position reporting system, a more rigorous *ex post* prosecution methodology and certain amount of emergency anti-manipulation firepower by regulators. To our judgement, this approach to regulating against futures manipulation may be more cost-effectively justified than the current US system. Manipulation clearly motivated futures regulation in the US, but has not been the basis for any legislative and regulatory concern in the UK. We therefore explored specifically how more cost-effective futures regulation may be achieved in the UK. The measures we proposed include, modifying the FSAct or reinterpreting the relevant provisions of the FSAct (by a designated regulatory body or English courts) to make statutory prohibition of futures manipulation; establishing an effective anti-manipulation framework; and revising some seemingly costly and unenforceable investor protection rules. Moreover, recent trends in futures trading, including globalisation, continuously increased size and scope of futures trading, and the fast growth rate of OTC trading compared with on-exchange trading also challenge futures regulation in an important way. It is predictable that there will be greater regulatory convergence on financial regulation in the future, both domestically and internationally. The implications for regulation against manipulation are also far-reaching. Since manipulation schemes may become more complicated, coordination of strategies in different markets or using instruments may become more simple and widespread, effective regulation against manipulation may therefore require greater expertise and greater domestic as well as international regulatory cooperation.

This research is by no means exhausted. Many unsettled questions in this field await further research. For example, equilibrium analysis of futures manipulation with several large traders, or one or several large hedgers with market power in a market; investigations of manipulation schemes through co-ordinating strategies in options markets, futures markets and OTC markets; examinations of manipulation strategies in more general futures markets, such as interest rates futures and stock index futures, etc. Manipulation has been reported and modeled on the US Treasury securities market (see, for example, Cornell and Shapiro 1989, Jegadeesh 1993, Chatterjea and Jarrow 1998), and its potential in financial futures markets with cash settlement was investigated by Kumar and Seppi (1992). Of course, the mechanisms involved in manipulation in these markets may be greatly different from that in commodity futures markets, but the effects of these manipulations nevertheless require an analysis. These questions are important for restructuring the futures (derivatives) regulatory system. We cannot expect to resolve all these questions in this research. Nevertheless, we hope this thesis may stimulate informed debates on the issues of futures (derivatives) manipulation and their public policy implications.



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